"THESE TECHNIQUES AND CONCEPTS WILL HELP ANY PILOT FLY BETTER"

Stephan Stiegler
Former World Champion

MASTERING PARAGLIDING

Kelly Farina

DIGITAL EDITION VOLUME 1

MASTERING
PARAGLIDING

VOLUME 1
Kelly Farina

THE ART OF PARAGLIDING

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Cross Country
In the core, since 1988

About this book

Mastering Paragliding has been in the air for several years, ever since Kelly Farina first mentioned to us that he was writing a book. A paragliding guide for more than a decade, Kelly is a regular contributor to Cross Country Magazine. His passion for helping others to enjoy the sport safely is at the core of everything he does, and his enthusiasm and direct style shine through.

When Kelly emailed to let us know that he had, in fact, finished his book we grabbed him and the manuscript to talk. What we realised after reading it was that this wasn't simply another 'How to Fly' book; this is a philosophy and approach to flying that can underpin everyone's journey through the sport. The concept of the Pyramid of Progression seems simple but has never been widely applied to free flight before. It will open the eyes of many who have worked their way through their flying career for years 'learning by doing', and it will help many new and intermediate pilots find and stay on the right track. Learning to fly is a journey, and this book helps pilots see the path they are on. Thanks to all those who have helped put it together. Enjoy the book, and enjoy the adventure that free flight offers. See you in the air!

The Cross Country Team

eBook edition

This ebook edition was first published in January 2018. The print book has been split into two volumes, adapted for e-readers and for file-size for easier downloading. Each volume of the ebook contains the same chapters and content as the original print book, although some non-essential photographs and illustrations have been omitted.

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This is not a teach-yourself manual – learn with a qualified instructor. Free flight is an evolving discipline, it pays to keep up to date with current theories, equipment and advice. Contact the author at **www.austrianarena.com**

About Cross Country magazine

Cross Country has been reflecting our passion for flying since 1988. The magazine is now read by paraglider pilots, hang glider pilots and paramotor pilots in over 75 countries.

The printed magazine has the highest production qualities, and you can read the digital version on your tablet, phone or laptop.

Cross Country articles are widely recommended by instructors and coaches. With contributors like Bruce Goldsmith, Kelly Farina and Honza Rejmanek, Cross Country gives the latest knowledge in this fast-moving sport.

The magazine review team aims to get under the skins of the newest gliders to help you make a more informed choice. We also review harnesses, instruments and other useful new gear.

However, Cross Country's soul is in the adventure and freedom of flying. As pilots, it's a passion we share, and our magazine serves as a campfire that we can all gather around to swap stories.

Whether it's intoxicating tales from Brazil or the Himalayas, first-hand accounts of record-breaking flights or simple stories of unexpected moments in this extraordinary sport, Cross Country aims to convey that feeling of being up there, in the moment, doing what we adore.

Meanwhile, correspondents bring news, reviews, opinion and insightful comment on the latest happenings in the free-flying world.

Subscribers receive ten issues per year, the Travel Guide, and are also entered into the annual Subscribers' Draw to win a new wing.

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Praise for Mastering Paragliding

"The concepts here can help pilots of all levels achieve more success when flying XC. It is great to see these principles written down so clearly"
Thomas Walder, world record holder and Austrian Paragliding Champion

"Finally these concepts have been written down in a clear, concise manner. The chapter on thermalling is a great starting point for any pilot who wants to own a stronger climbing technique"
Russell Ogden, British Champion and Ozone development pilot

"Flying fast is the highest level of flying and relies on having the basics dialled, from thermalling to route planning. The principles in this book will help pilots understand how to get better and fly faster"
Stephan Stiegler, former Paragliding World Champion, designer at AirDesign

"I wish I'd had this book when I'd started flying XC, especially when I first flew in the Alps"
Josh Cohn, USHPA Magazine

Interview with the author
Listen to a podcast with Kelly Farina, author of Mastering Paragliding
http://www.cloudbasemayhem.com/episode-26-kelly-farina-and-mastering-paragliding/

"A mind is like a parachute.
It doesn't work if it isn't open."
Frank Zappa

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Kelly’s world

KELLY FARINA WingTsun and paragliding student, both are life-long journeys

IT SEEMS a lifetime ago that I first entered the sport. Back then, in the mid-90s, I dedicated all my energy towards my new passion and took any job that allowed me maximum free time, despite its lack of monetary compensation. Being young allowed me to believe that anything was possible. Where there was a will, there was a way.

In those early years I spent my priceless free time on either flying, or just sitting on a mountain somewhere watching the weather change. Living the slow but marked breakdown of the föhn until the clockwork arrival of the next cold front was simply a way to while away days in the Alps. Time few of us have to ‘waste’ these days.

Looking back, this early period, although vital, proved to be a clumsy way to learn. I was learning by doing, mainly from my peers, without any structure or plan. (Those peers happened to be among some of the world’s top pilots, and some of them have been kind enough to feature later in these pages).

However, as long as I was racking up hundreds of hours it didn’t seem to matter. Experience was experience, or so I thought. If only

I'd understood then what I do now – that age old problem.

At the turn of the new millennium I started to help visiting pilots come and enjoy rewarding XC flights around my home territory, the Zillertal Valley in Austria. Back then our XC courses were mainly 'follow the leader' tours with little structure or real learning. Although I soon realised that something was lacking in pilots' post-school education, I could not put my finger on what it was. Turns out it was simply missing structure.

Fast forward to the late 2000s. After 10 years of competing internationally, stashing world ranking points and gaining a coveted place on the British national team, it was time for a change. This change was crucial to my personal evolution. First, it changed how I'd go on to look at our sport. Secondly, it radically altered how I'd pass my knowledge on. It marked a milestone as I finally turned my back on the racing scene, which with hindsight was the right choice.

It was also an important time as I would stumble upon another black art that would go on to crystallise the concepts and ideas found within this book. That black art is the martial art known as Wing Tsun.

Borrowing their ideas, converting their syllabus and making it relevant to paragliding enabled me to help pilots reach a much higher level in a shorter time, with a clearer understanding of why it's done this way. By breaking our art down into a logical progression of learning, and by using basic drills and concepts, I attempted to quantify the learning progression of our own black art, paragliding.

It's still evolving, and the techniques may change over time, but as long as we wish to play with physics while travelling the landscape using only the sun as our fuel, then these concepts are arguably set in stone.

Kelly Farina

The goal is the journey as a whole

WELCOME to Mastering Paragliding. This book is designed to help you make clearer and faster progression through our sport at every stage of your flying career, whether you're making your first short hops or chasing glory in the XC leagues. In it we'll pursue concepts that will allow free-thinking pilots to craft a style true to the fundamentals of efficient soaring flight. We'll go from playing with physics while carving clean lines around the sky, to eventually covering incredible distances by following nature's flow.

Techniques and style differ from pilot to pilot, but some principles bind all competent XC flyers together. Those principles are arguably set in stone. The end result is greater efficiency, which is essential for anyone truly interested in travelling using only the sun as their fuel.

In our sport it doesn't really matter how good you are – it's about having fun and getting away from our normal lives. But it can't hurt to understand what we do better, so we can enjoy long and challenging three-dimensional chess games with nature, or short but sweet sessions after work on a local hill. The main thing is that it's safe and we're having fun.

In these pages we'll discuss when to call it a day in the face of cloud development, and why the same pilots climb out time after time, making it look ridiculously easy. We'll learn how to carve the sky and centre on the core like never before, to take the luck away from deciding where to search for the next moonbeam ride. We'll talk about planning and executing routes around complex valley systems, and adapting lines to coincide with changing conditions. We'll understand how to read the sky, maximise the day or even beat fellow competitors over the finish line.

This is no 'how to' manual, but more a rough guide to a logical path of progression. Crawl before you walk, walk before you run. Understand this, and real progress is sure to follow.

The road to progress

When we're signed off by our instructors, we have the minimum basic skills. We can most likely do simple assessments of site and weather. We should be able to launch and land independently, causing minimum disruption to those sharing the sky around us. But we possess few of the tools needed to be skilled, well-rounded pilots..

If our skill-set is a toolbox, the beginner is armed with little more than a monkey wrench. But sometimes, in strong, turbulent skies, we may need a hammer. Quick, precise reactions and timing are required, but nerves play a part here, too. At other times we may need a watchmaker's screwdriver, for the light, stable technical days when technique is everything.

Which tool we need depends entirely on the conditions. Having only heavy tools when subtlety is required will see pilots land frustratingly early, wondering how others are even staying up. Pilots should have a toolbox full of well-practised techniques. Softer skills are much more technical and harder to acquire. Simply understanding the differences between novices and the highly skilled is an important part of the puzzle.

After two decades of flying paragliders, and more interestingly over a decade of watching other pilots learn, I realised that there's little or no post-school training, let alone a structured, logical way of progressing safely in our unique sport. We face the lengthy task of working it all out for ourselves by trial and error. That's slow, frustrating and time-consuming. In a sport both fickle and weather dependent, free flight is a black art that can take countless hours to perfect. But with a structured syllabus, the road to progress starts to become clearer.

Think of the following as a map of progression, on which each stage needs to be practised and understood before you move on. Pilots will still need to practise their techniques to improve, but they'll be on the right path. They'll be able to avoid countless hours of 'learning by doing', which can mean training themselves in faulty techniques. That can be an extremely slow way to progress, relying too much on luck. It can also be dangerous, especially in the Alps.

Flying into leeside thermals low down in a strong valley wind may show you the top of your glider, or even the colour of your reserve.

Approaching the sport that way makes it hard and frustrating to progress quickly and safely, especially as most pilots have lives outside paragliding. Work and family commitments can hinder progress that is already painfully slow.

Personal development

When learning any subtle 'black art', there should come a time when the student (and we're all students) comes to realise that the more you learn, the more you see how much more there is to learn. This is what keeps us all addicted.

Any sport or game that you can master in five minutes will soon hold little interest. Acquiring knowledge and understanding of a subject can be likened to moving slowing through an exponentially widening tunnel, something like a trumpet. In the beginning, a pilot's overview is very small; the tunnel is tight. With every step the tunnel opens up, showing that there's more and more to learn ahead.

It's important to move along this hypothetical tunnel at the correct speed and in the correct direction. Steps should not be skipped. Again, crawl before you run. Each step should be trained; the basics especially must be trained to a high level, as these are the foundations for reaching the higher levels of the sport. These basics are not easy – in fact, easy is not a word bandied about these pages. Sorry!

Eventually the pilot will stand close to the widest part of the tunnel. Once you're here, the experience gleaned over the years is expansive, and the overview as large as it gets. Fine tuning is all you can expect thereafter.

However, if you could teleport a beginner to this point without the context of the previous steps, there would be extreme confusion. Step-by-step is the correct way – and in the correct direction.

As we progress, we become able to think less about our immediate activity and closest surroundings. Think of these as spheres of concentration.

In the beginning, when we thermal, our sphere is small. We concentrate on controlling the wing, and have little or no processing power to visualise the climb we are in. These spheres expand until eventually we can run most of them on muscle memory, and this gives us free brain power to play the game.

We can think of it like this: thermalling is learning how the pieces move, while XC planning is the strategy of the game.

The spheres eventually expand until pilots can climb without thinking, and can then make decisions about what's happening far down route. In the meantime they'll also look around for someone or something climbing better than them within striking distance.

Skills that run on muscle memory allow observation to thrive. Later on we'll talk about this secret weapon of all good XC pilots: our observation.

The four stages of understanding

It is said that there are four stages of understanding a subject, or a division of it. This applies especially when the subject, or in our instance the sport, is based on feeling, balance and timing.

Think of your body as a machine that needs to react without conscious and sometimes clumsy thought getting in the way. The deeper the following techniques are embedded in muscle memory, the more effective your machine will be.

In examining these four stages, it's important to be honest with yourself on each level. Then, and only then, will it be clear where work is to be done.

Unconscious incompetence

This is the first stage. This is where most new pilots will find themselves. It means they don't realise that they can't do the task at hand. At this level, the pilot knows very little about what's required to succeed. We hope, of course, that this phase is short-lived.

Conscious incompetence

The second stage. This is the important step when the pilot realises that he or she is struggling at the task in hand or the sport as a whole. This is the first real step in understanding how little we truly

understand. And it's a great position to be in, as it means the pilot is now ready to learn.

Conscious competence

This next stage happens after a lot of concentration and practice. Conscious competence involves being able to perform the task to a good level, but only when vast amounts of brain power are available to manage it. You're not quite on autopilot, but the technique is there or thereabouts.

Distractions, traffic, turbulence or decision-making will see a loss of efficiency. Once the distraction is over, the pilot can go back to dedicating the required bandwidth of processing power towards the task.

Unconscious competence

This is the final stage and is what all pilots should strive for. This means all actions are on autopilot. No bandwidth is needed to perform the task; we're multi-tasking to a high level, without conscious thought getting in the way.

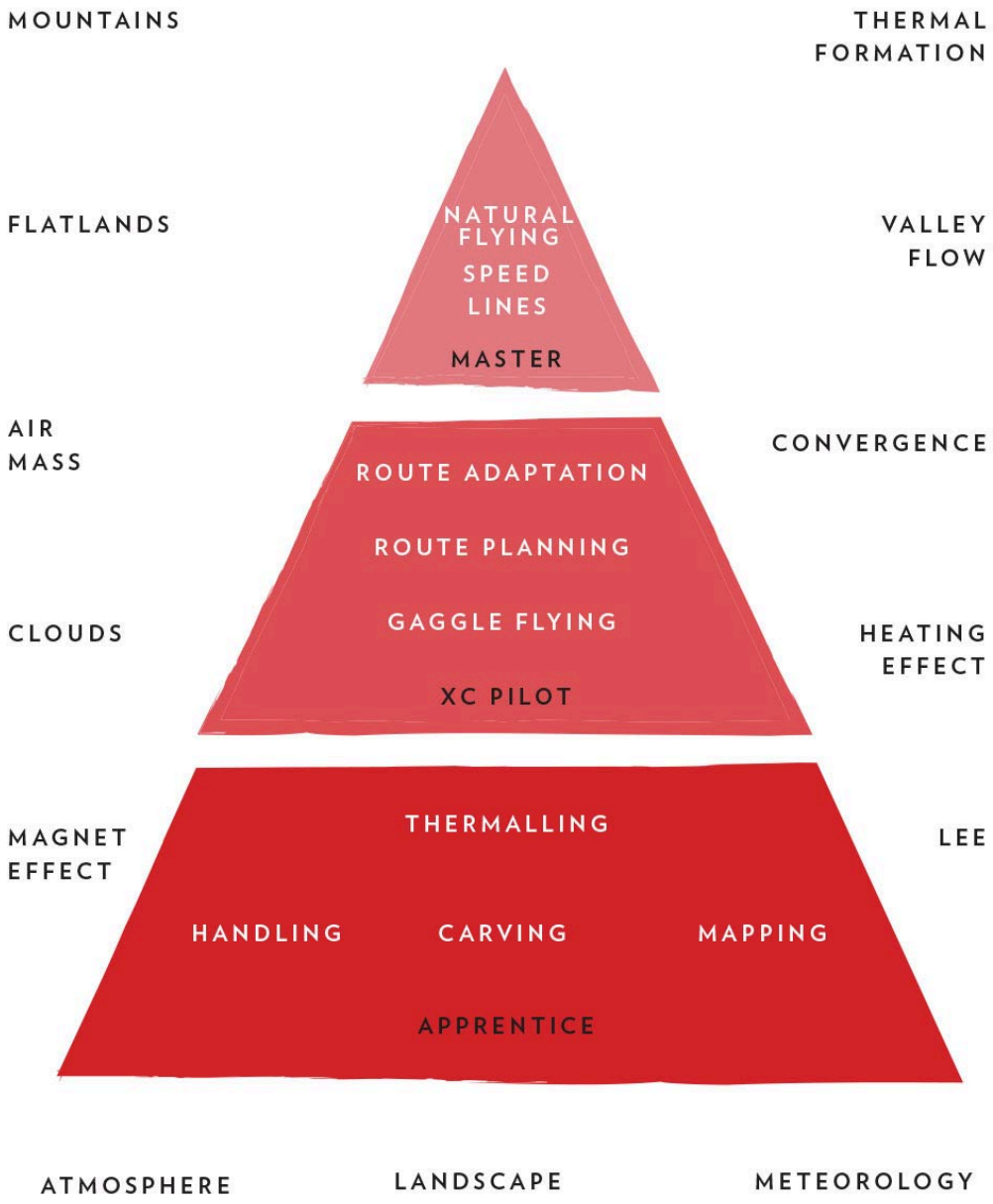
We react to any situation in real time, and as with many things in life, the earlier we react the less we have to react. Flights become much less mentally tiring when pilots are relaxed and their minds are free to make unhurried decisions.

We talked about the spheres of interaction; in this final stage of unconscious competence, the pilot can look way beyond the constrictions of these spheres – looking way down track, scanning the sky, watching cloud cycles and planning and executing moves.

The pilot can do this effortlessly because the mechanical means of carving clean lines and hunting/staying in the core are embedded deep in muscle memory. From here, the 3D chess game with nature can flow; pilots feel involved, not just passengers making lucky moves.

The good XC pilots seem to be lucky all the time, suggesting that luck has very little to do with it.

Pyramid of progression



PYRAMID OF PROGRESSION

MANY PILOTS aspire to fly long-haul XC flights over the chessboard of their choosing, whether that be the complex high terrain of the Zillertal Alps or the arid flatlands of central Spain. Before those dreams are realised it's important to have the basics in hand. Thermalling is a cornerstone, and to some degree so is launching.

Please don't get confused when I mention the word basics. There's nothing basic about these skills. Without them, anything we try to do will rely on strong conditions and good fortune. Remember that good XC pilots tend to rely on solid technique, and a lot less on Lady Luck. You could even say they create their own luck. Everyone climbs out when it's strong – just hold on for the ride. The skill lies in being able to recover if nature deals you a bum hand.

When a long glide to a cloud fails to produce the strong climb that it promised, being able to think and adapt and even squeeze what little lift is still there can mean the difference between going down or salvaging the flight. Low saves are normally needed when something has gone wrong. Efficient turns in light, tight lift together with the ability to sniff out and stay with the core: these skills are crucial for a well-rounded XC pilot.

Over the years I've noticed that many pilots believe that thermalling is simple and that the XC part is the hard part. This couldn't be further from the truth. In reality it's the polar opposite, although in the flow of progress thermalling comes before XC route planning. That's because it's impossible to link thermals into XC if making efficient turns still eludes our pilot.

Therefore, after launching, learning to thermal properly is the most important skill, period. The XC part is just following the rules of a game. Adapting the route is only possible when the pilot is doing things on autopilot. The bandwidth or processing power of the pilot is crucial if he's to make decisions based on what he observes. If there's no available bandwidth random moves will follow, relying on luck or, worse, the passive safety of his equipment. A random move might happen to blunder a pilot into an unexpected area of rotor, for example. There's no longevity in this method.

This book, the subject matter of our courses at Austrian Arena, will try to clarify and structure the learning process. Structure is extremely important in the sport. I'll give a simple example. A pilot can't map or turn efficiently in the thermals that he blunders into. So he needs very strong and wide lift to compensate for his lack of real technique. However, he has the perfect route planned after studying XContest for the past few seasons.

He launches early, as he's attempting a long XC flight in the Alps. The thermals are weaker than he expected and his mapping skills (or lack of them) and jerky swing-throughs see him slide off the hill and bomb out. If only he'd spent more time on his thermalling and mapping techniques and less time on the internet, I'm sure that elusive 100km triangle would eventually be his. Stop chasing numbers; train the basics in a structured and methodical way.

Thermalling well is undoubtedly the key to XC flying, but many pilots wish to skip this part. They trade up to hotter wings, hoping that the better sink rate will compensate for their lack of technique. A common theme throughout this book is the saying: "The fewer mistakes you make, the less performance you really need." A lot of incidents can be prevented if pilots understand this early on. Over the years I've seen too many pilots hurt or scared because they've flown with unsuitable equipment.

The attitude that "it's normal to have collapses" is bandied about. This is not strictly true. In my experience it means that either the wing is too hot, the day is too violent or your location is wrong – you're in the lee or hanging around inverted air.

Personally I try to keep the wing open at all times. I don't want to rely on its passive safety. I'm not referring to small tip tucks here, but to deflations that, overcorrected, can lead to the dreaded cascade.

Modern paragliders are often only one collapse away from a cravat. It follows that we're only one cravat away from a reserve throw, and then all bets are off. So prevention is way better than cure. It's about not only active piloting, but also choosing one's battles carefully.

If we now understand that structure will help progression, what is the structure of progression in free flight and especially paragliding? Some may argue, but I see it like this.

Basics

1. Ground handling. A strong technique is required that delivers us safely into the air, most importantly when we decide.

2. Turning the glider efficiently and learning to flow around the sky – the carve.
3. Mapping the climb that you're in by opening and closing this flow, the carve, towards ever-stronger lift: centring.

Higher level

4. Route planning: learning the rules of the game.
5. Route adaptation: when the planned route will no longer work because of outside circumstances, time or conditions, we need another route plan – and this planning has to be done in the air.

Efficiency tools

6. Lines to take over terrain and on crossings; historically good lines. This is route adaptation in the moment. Plus the ability to glide well down these lines.
7. Speed to fly: not just a heavy foot, but learning to judge where to push on and where to invest – not squander – time. Also, techniques for holding the nose open at speed and knowing how much speed to give. More importantly, to flow – avoid getting stuck.

Nirvana

8. Natural flying: no instruments, the true free flight Nirvana that everyone should eventually strive for.

Mental bandwidth

Each level has many topics and concepts, which we will examine throughout this book. The main reason why this progression is set out like this can be explained in the following example. It's all about the bandwidth available to be free to think about the next level.

A pilot who is on launch, confident in their chosen launch technique, will have the mental bandwidth available to observe the conditions unfold properly. Choosing the moment to launch, he or she will use the right tool for the job: either alpine or reverse launch.

A well-rounded pilot will have practised enough so that he can go when he wants – not breathing loudly, staring uphill at his wing, missing all the information going on behind him. A confident pilot will be looking over his shoulder, waiting for the right moment to go.

This pilot will have a better chance to stay up, as he'll undoubtedly launch when he witnesses someone or something climbing within easy distance of launch. Launch at the right time, and there'll be a better chance of staying up. Strong technique when launching is the key to the rest.

Deliberate choice of timing and location will avoid blunders. Simple observation on launch gives more chances to connect with a climb. This in turn will enable that pilot to train the next level, carving: flowing around the sky smoothly and avoiding height lost to jerky, unchecked dives.

The lighter the conditions, the more important efficiency is. This difference alone can see one pilot climb better than another, all things being equal.

Practise efficient carving enough, and before long it will become your style. Embedded in muscle memory, little or no thought is given to keeping the carve smooth and true.

Balance and timing are the key here. Once some bandwidth is freed up from the carve, our pilot can start to appreciate which side of the climb holds the stronger surge. Then comes the practice of opening and closing the carve smoothly in the right direction.

At first it will be rough, but over time the finesse will develop. There'll be understanding of not only the correct direction in which to move the perfect yet imperfect circle, but also the amount of time to open it for. The closer you stay to the core, the smaller the adjustments needed.

Basic doesn't mean easy

These techniques are the basics, but never confuse them with being easy. If you practise them enough, you can take advantage of all the useable thermals that nature throws at us, until climbs become either too tight or too light for us to gain height. This is what makes climbs and days technical.

I hope you'll have noticed now that just through having launching in our grasp we can make a quicker progression, and brain power can be used to think about the next step.

Running the basics on autopilot frees mental bandwidth for making decisions. Knowing what made a strong route when you were planning on the ground is vital. Adaptation of routes becomes easier and more logical – it's not just rolling dice.

Autopilot allows a new route to be conceived on the fly, as it were, whether it be big changes because of macro circumstances or route adaptation in the moment, choosing lines. Our flights become longer; experience grows.

In the end, distances grow as our average speed increases.

The alpine launch

SLIPPING our gravitational bonds and leaving launch is always a special moment. There's no feeling like it, no matter how routine it becomes over time. It's only great however when it's done with control, without the need to test how bulletproof the wing's design is. Launching is a critical phase; it's where we're closest to the ground, moving sometimes with speed without the wing properly flying. It's where pilots can easily come unstuck, especially on unforgiving launches.

Gliders' launch characteristics have improved dramatically, and are one of the reasons why the sport has flourished in recent years. Having said that, visit any launch and watch a cross-section of pilots for long enough, and you'll witness good and bad launches. What makes one good and one bad? Control. The manner in which the pilot is delivered into the air is key. Style points aren't important, just a strong, safe technique. Falling on one's face on to the rocks at Ölüdeniz does nothing for your image or your looks.

There are two main ways to launch a paraglider: forward or reverse. Each includes several methods, like the light wind running reverse and the strong wind, kitesurfing-inspired cobra launch.

First we'll discuss the most simple and original method, the forward launch, commonly known as the alpine launch.

Alpine flying sites can enjoy light anabatic winds, depending of course on time of year, day and prevailing conditions. Pilots used to soaring sites usually dread these launches. Even light backwinds can plague them, despite strong thermic activity out front, although this usually happens only when launching on snow in late winter or early spring.

These pilots are usually used to ground handling before deciding when to launch. But alpine launching does not afford the pilot time to stand and admire the wing, choosing when to go. Once started, an alpine launch should be a set of fluid sections, with a controlled flow from one to the next until the decision is made to commit fully. Pull up, control, look, commit. A front stall at the last stage can be

either comedy gold or devastating, depending on the terrain. Grass launches usually allow mistakes, though nothing is guaranteed when running downhill at 20-25km/h and falling on one's face. Falling down a scree slope with half the wing open at these speeds could see loss of more than a little pride. A trip to casualty or the dentist can be on the cards.

Some common mistakes

Forward launches, done because of the lightness of the forward breeze or a complete lack of it, can be daunting to pilots who don't practise. Here are some of the main reasons that lead to the launch going wrong.

- Not checking properly that lines are free, or even clipping in wrongly.
- Charging downhill from the trailing edge with the lines totally slack – anything can happen.
- Too much impulse at the beginning that goes unchecked and leads to a front stall.
- Not standing in the centre of the wing, leading to an uneven pull-up.
- Dropping the hands leading to closure of the leading edge – the glider will not fly.
- Bending at the waist and closing the leading edge, again preventing the glider from flying.
- Not looking at the wing to check for knots in the lines, so taking off with a problem.
- Sitting down too early and jumping back, with the glider not flying. As the wing tries to fly the pilot will scrape the ground – not so funny over harsh terrain.

PREPARE Lay the wing out in a horseshoe shape, and stand in the centre with your back to the wing. Ensure there is equal pressure on the right and left risers. Stand at such a distance from the trailing edge that the lines have little slack in them, but you are not pulling on the leading edge.

PRESSURE With hands high and back straight a steady and equal impulse is given to the leading edge, hips driving forward.

CONTROL The wing is flying and any tendency to overshoot is corrected with the correct brake input. Scanning the wing and lines for knots we are ready to commit or stop, as we are still travelling relatively slowly.

COMMIT Satisfied everything is good it's time to commit. Hands high, head down. Note this is the first time that any real speed is given to the system.

Tips to make it perfect

There are so many different techniques that it would take too long to go over them one by one. So let's break it down, as usual, to concepts, or simply what are we trying to achieve.

- We wish to bring the glider up, to check that the profile is clean, to control any tendency to overshoot or roll, and of course to have the option to abort at any time before committing completely.
- Along with the above we need sensitivity, using smaller muscle groups, and a technique that goes with our own biomechanics.
- Glider layout is crucial. Pull the glider into a smooth arc on the ground and tension the leading edge slightly. This ensures that the tips don't inflate first, and gives a smooth and natural centre-to-tips inflation.
- The pilot must be in the centre of the wing with equal pressure on left and right A-risers. This will help pull the glider forward through the air evenly. We want to avoid a strong pull on either side. This will prevent unwanted yaw followed by potential roll.
- If the pilot is centred, he or she won't need to move under the low side of the wing during the pull-up phase, as there won't be a low side.
  He can concentrate on moving forward smoothly and safely.
- During the pull-up, the hands should be slightly above shoulder height in front of the face, equidistant from the nose, with a little tension between the risers and the karabiners. This will prevent the hands dropping and closing the leading edge.
- Think about your hand position for reverse launching – it's the same position, but facing the opposite way.
- The back should be straight and hips driving forward. Try not to bend at the waist as this will close the leading edge, making it slower to get
  off the ground.
- The forward impulse should be smooth with very little slack in the lines. Standing at the trailing edge and running full speed is not advised here. The start phase should be slow and controlled, with a gradual acceleration.
- Once the glider is overhead, connect to the trailing edge by applying the amount of brakes you need. Don't choke it, let it

fly!

- From your upright position it should be very easy to look up to make sure everything is fine. A quick glance is usually enough. With experience, pilots will feel an unfamiliar pull if the lines are not clean on the pull-up, but a visual check is still a good idea.
- This is why I prefer a running reverse in all but light backwind conditions, as I personally prefer to see that the lines are clean from the initial pull-up.
- Only when you're totally happy that the wing is level, straight, open, flying and knot-free should you lower your shoulders and start a strong run.
- Hacking off the hill with an imminent front stall on a steep launch is very bad for your health, as is trying to fix something that was wonky from the beginning. It's better to be slow, controlled and ready to stop at any moment until you're committed. It can mean the difference between a great flight and a frustrating – wow that was too close! – short hop.

The reverse launch: thou shalt not hack

OVER many years I've visited hundreds of sites in dozens of countries. It soon became apparent that there was no standard method for teaching reverse launches. Different nationalities adopt different methods. Some seemed not to teach it at all.

Even recently I witnessed one school whose teaching started by clipping the student in backwards, facing the wing with the brakes not crossed. This just confuses students. Experience has shown that confusion normally leads to feeling awkward and clumsy. An unwillingness to practise follows. It's important that we practise something that works: style is irrelevant. Safety matters in our sport.

Some even still teach a method that should have died out in the mid-90s, in which the brakes are not crossed, but the pilot has to drop and then catch the brake handles in the correct hands after turning. The reasons why this is not a valid method are obvious, and we won't discuss it any further.

Common errors

The first very common mistake made when reverse launching is overshooting from an overzealous pull. The wing usually front-stalls onto the pilot's head. This normally happens if the pilot is too static; sometimes he's even lifted off the ground if he applies the brakes heavily. In lighter conditions it happens purely because of unchecked forward pitch.

Another mistake is constantly whacking the wing back on to the ground through being heavy-handed. This usually comes from too much brake or not enough roll control, moving left or right to remain underneath the wing. Up, down, up, down... It's very hard on our equipment in the long run.

The last is what I call 'the hack' – when a pilot just goes for it without much in the way of control, hoping that the glider's passive safety will carry him off the hill safely. There's little to no longevity in

this method. If it succeeds, it's followed by a lot of swinging around, and sighs of relief from any spectators.

The three main methods

Pilots seem to defend their techniques like a fanatic defends religion. They feel insulted at the very idea that there may be another solution to the problem at hand. If what you currently use works for you, keep it – but try to be open-minded, and we may learn something as a community. A wiser man than me once said: "A mind is like a parachute. It doesn't work if it isn't open."

All methods out there can lead, with practice, to a stress-free launch. I'm not suggesting in this section that there's just one valid method. All have plus and minus points. I want here to shine a light on what other techniques are available.

The method I mainly use was passed down to me. It seemed to have no name, so I've called it the Three-Axis Method. As I see it, there are three main techniques and many variations on the three themes: the Cross-brakes, Mitsos and Three-Axis methods. Before I go into the details, potential flaws and strengths of all three, I'd first like to get down to basics – the concept of what we're trying to achieve, and therefore the expectations of the techniques used. All are valid for different reasons; some, though, are more valid than others.

The basic concept

When we try to launch our wings, we ideally require simultaneous control of roll, pitch and yaw. If we have to sacrifice any of the three, we're using a weaker technique. We can and do expect our gliders while they're airborne to be controlled three-dimensionally with precision.

For example, any groundhandling method that gives up control of positive pitch in order to control negative pitch and yaw is logically less valid then one that requires no swapping of one for another. All three axes should be under control at any one time. I believe a method that has all six directions of axis control covered has to be logically more valid.

The six axis directions are as follows:

- Positive and negative pitch
- Left and right roll
- Left and right yaw

(Strictly speaking, there are eight, if we include left positive and negative yaw, and right positive and negative yaw.)

A little idea

"Any method that enables the pilot to control all three axes simultaneously without swapping one axis for another, without needing clumsy 'patches' (such as swapping of hands), logically has to be stronger than another method."

This is irrespective of which techniques are used to achieve our goal: a controlled safe launch. We're talking here about the pure concept. But if you agree that the last statement has some merit, we're free to move on to the different techniques.

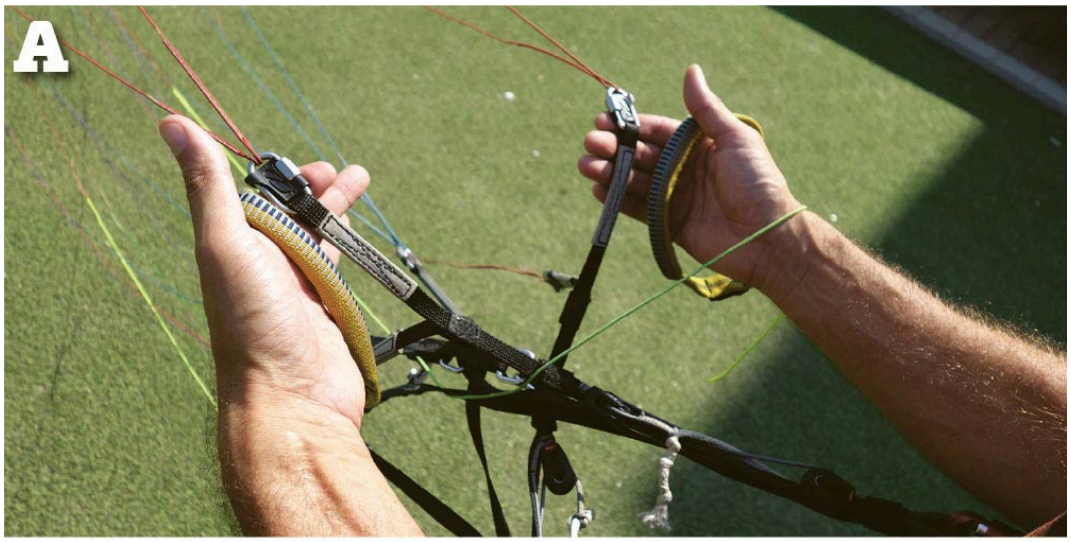
Just to be crystal clear:

Pitch: positive pitch is induced by pulling on the A-risers or releasing brakes.

Negative pitch: is controlled by rear risers or both brakes. It's applied equally, or it induces a yaw effect.

Yaw: for left yaw simply slowly pull down the left side, by pulling the left brake. For right yaw, the opposite.

Roll: left and right roll are corrected or influenced by the pilot walking left and right under the wing. Brake the high side, walk to the low side.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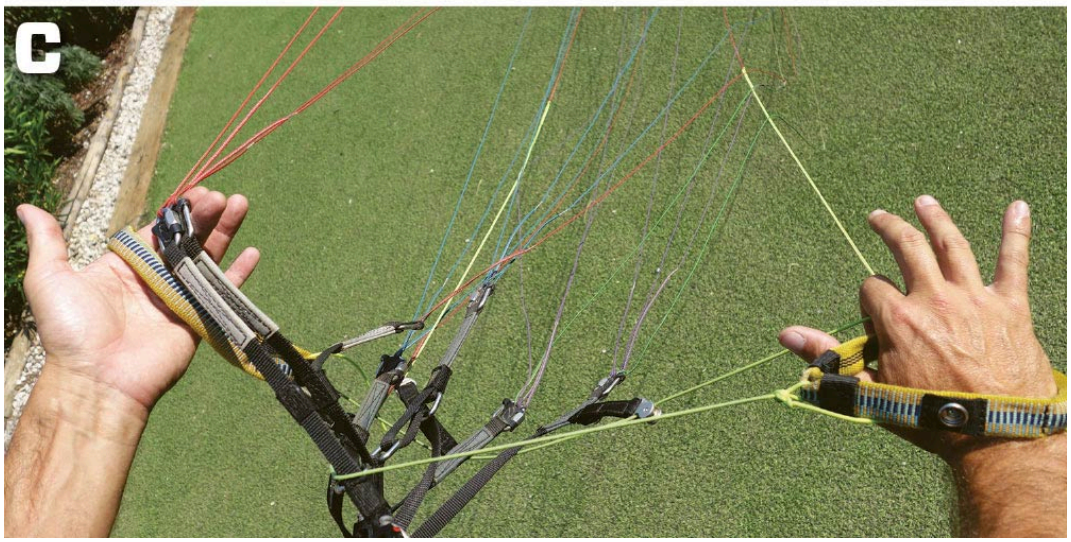
B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REVERSE LAUNCH TECHNIQUES

A: Cross-brakes method

B: Mitsos method.

C: Three-axis method.

Cross-brakes method

This is how I was taught. Build a wall with crossed brakes and crossed risers. Have an A-riser in each hand. When the glider is almost up, let the As go and control the trailing edge with the brakes, hoping the wall was built straight.

Pros: it's straightforward and easy to teach, and no swapping of hands is required. The brakes are already crossed, which will help the pilot's coordination. Not crossing the brakes would mean a brake swap, and it's generally a bad idea to let go of something crucial to control at a crucial time.

Cons: the initial phase has only positive pitch control – there's no negative pitch or yaw control. If the glider comes up wonky the pilot has limited influence. If he overcooks it on the brakes, the wing simply falls down.

It's easy for the wing to overshoot and front stall, especially if the wind's strong and a hard pull on the As is given. It's also easy to get lifted if the speed of the rising wing goes unchecked. You can take the power out by walking or sometimes running towards the wing. If it shoots over your head and you yank the brakes, expect to be lifted off the ground facing the wrong way, an unpleasant way to leave the ground. Note that it is possible to overshoot and front stall with all methods.

Mitsos method

The Mitsos method was developed by Mark Mitsos back in the mid-90s, primarily as a technique to use in strong winds. Twenty years on it's still a very valid method.

It requires the pilot to stand in the middle of the glider as usual, with the As in one hand and the rear risers in the other. As the As are pulled to initiate the rise of the nose, the rear risers are also pulled depending on the effect required. Sometimes a lot more rear

action is required; usually the stronger the wind, the more input into the rear risers.

Once the glider is overhead the rear risers can be slowly released. Then the glider can be controlled with the brakes alone again. This method is still recommended for extremely windy take-offs, but requires some skill and practice to apply the right amount of rear-riser input.

The ability to kill the wing if it goes wrong with a twist and pull of the rear risers is the best part of this technique. It's therefore used when other methods could leave pilots vulnerable to a dragging if they get it wrong. Remember, brakes won't always get you out of trouble.

Pros: it's great in strong, laminar conditions. It gives strong negative pitch control, and the glider rises slowly and under control. It's ideal on coastal sites. It offers good positive and negative pitch control, and some yaw control. It requires no clumsy patches or swapping of hands.

Cons: there's limited yaw authority, which is needed if the wind is light or you're on a thermic launch. Holding the rear risers is just a security blanket in light winds. Overall, you have limited control in light conditions.

Horses for courses – it's a strong-wind method and a very valid one at that. It ticks most boxes unless it's light; this is where a pilot's flexibility and launch skillset come into play.

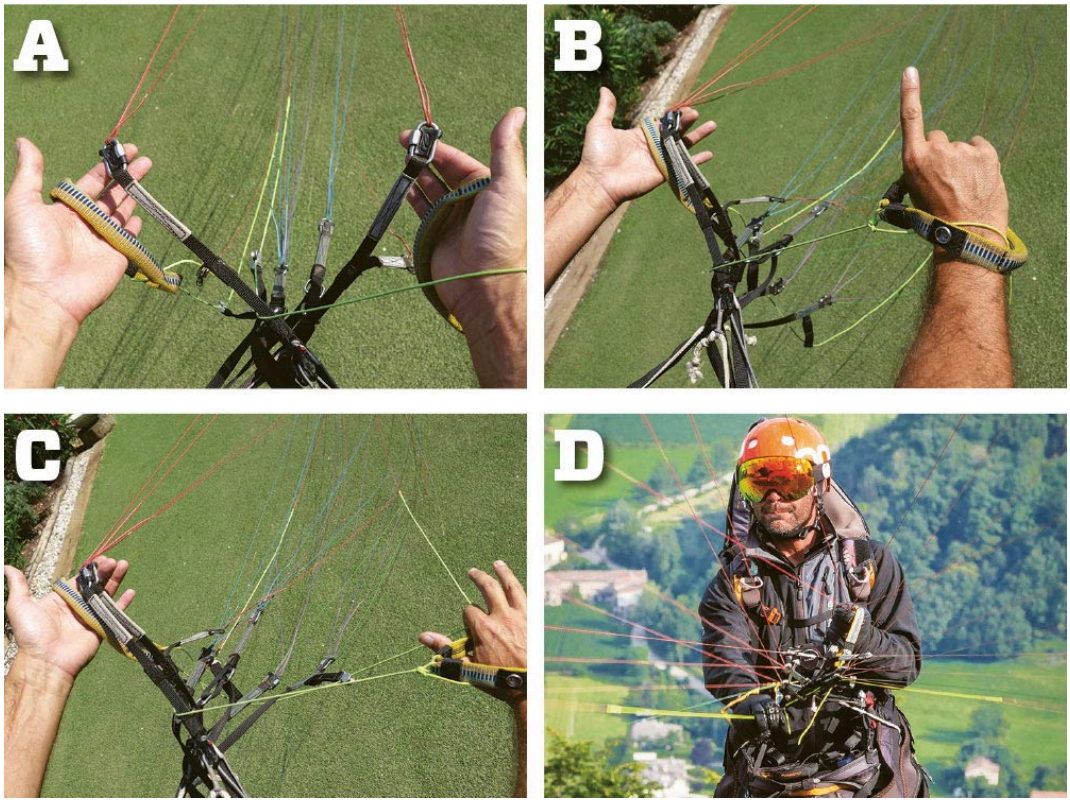
Three-axis method

First I have to say that I didn't invent this method; I only gave it a logical name. It was passed down to me by the more experienced pilots in our club, the Golden Eagles.

I don't know who first used or developed the method, but I thank them as this is the most useful launching tool we have and the one I pass on to all who are interested in learning a solid technique. It's one that doesn't rely on luck, but truly enables the pilot to control all three axes of movement all the way through the launch, with no need for clumsy patches or hand swaps. It enables 3D control of the

wing, and it's remarkably easy to train once pilots understand the subtle concept behind it.

As the magic happens on the trailing edge of the glider, I recommend that you use your weaker or less dextrous hand on the A-risers. We'll call this the 'grunt' hand for future reference and the other hand, your writing hand, the 'boss' hand. This is easy to explain as it requires very little finesse to pull the glider up; the dexterity of your boss hand is wasted on such a menial task. It's pretty much just on or off at varying degrees of pressure. It's still subtle, but not as subtle as what we're feeling for and doing on the trailing edge.



A CLOSER LOOK AT THE THREE-AXIS METHOD

A: First cross both risers and brakes, exactly the way you approach the standard cross-brake method

B: Put both risers in your non-dominant hand. Get ready to grab the other brake line with your 'boss hand' finger

C: Hooking a finger like this allows you to slide it up and down the line, which applies the opposite brake

D: Slowly pulling the A-risers towards your chest will see the nose inflate and start to rise

Photos: Kelly Farina / Rebecca Hedges.

Step by step

Turn and face the wing as you would in any reverse launch. Cross the brakes with the handles in the correct hands, so no swapping is required. Put both centre-As in your grunt hand. This is my left hand, as I'm right handed. This is important.

- With your index finger from your boss hand, find and hook the brake line that comes from the handle you are holding in your grunt hand. Make sure it's at the bottom of the lines and running freely. Hooking the line enables the pilot to slide the finger up and down the line: this applies the opposite brake, the one held in the boss hand.
- Slowly pulling the A-risers towards the pilot's chest will see the nose inflate and start to rise. If the wing is 100% straight, little action is required except some negative pitch control. This is achieved by slowly easing the A-riser pressure, then sliding the hooked finger high up the line and also tweaking that line, applying both brakes as needed. It's a case of understanding the biting point of both brakes. Keeping the arms and fingers relaxed will give the pilot the crucial information as to how much brake is required, through tension in the line and therefore on the trailing edge.
- The A-risers should be held together throughout these phases. They're released only when the pilot is ready to turn and control the wing purely with the brakes. Any overcooking of the brake control will see the wing drop back. This can be corrected with a slow and steady pull on the A-risers: positive pitch.
- If the wing comes up crooked, simply keep the pressure on the As and either apply the finger or slide the hand up the line, applying the other brake, all the time allowing the wing to fly forward. With practice pilots become accustomed to the relevant pressure felt in either hand or finger. After a while, pilots may

wish to release the hooked line to give more control to that side, and then find the grunt hand's brake line again when needed. It's easy to find, because of the natural bow in the line that separates it from the rear lines.

- It's even possible in stronger gusts, when still facing the wing, to release the As and go straight to the rear risers, one riser in each hand. Brakes are still crossed and in the correct hands, of course. When the gust subsides, you can grab the As again and control the wing as normal. This gives us the best of both worlds, as in strong winds when attached to 25m2 of sailcloth, I like the option to be able to twist, pull and kill the wing on the rear risers. No one likes a dragging.
- Once you're happy everything is as it should be, it's time to release the As, turn the correct way and launch when ready. Remember, practice makes perfect.

Pros: all three axes of control are in the hand throughout. No sacrificing one axis for another. It's as simple as that. With practice it prevents the up, down, whack, up, down, whack, and so lengthens the life of our equipment. Pull up, control, turn and go. It's ideal for running reverses.

Cons: it can be a handful in stronger winds (25km/h+) as the brakes are engaged, not the rear risers. Mitsos is a better solution on windy launches, especially windy unforgiving ones.

To sum up

Over time, pilots may develop tunnel vision. They do it the way they've always done it, even though it's a struggle.

Resist coming to launch blinkered. If nature throws a certain shape, you need to adapt to that shape. Use the right tool for the job. However, it only helps to look in our toolbox if we possess the tools or techniques in the first place.

If you're on a strong coastal site, the Mitsos is better suited, but don't use this launch method in zero wind when an alpine launch is obviously the right answer. Remember, we should practise

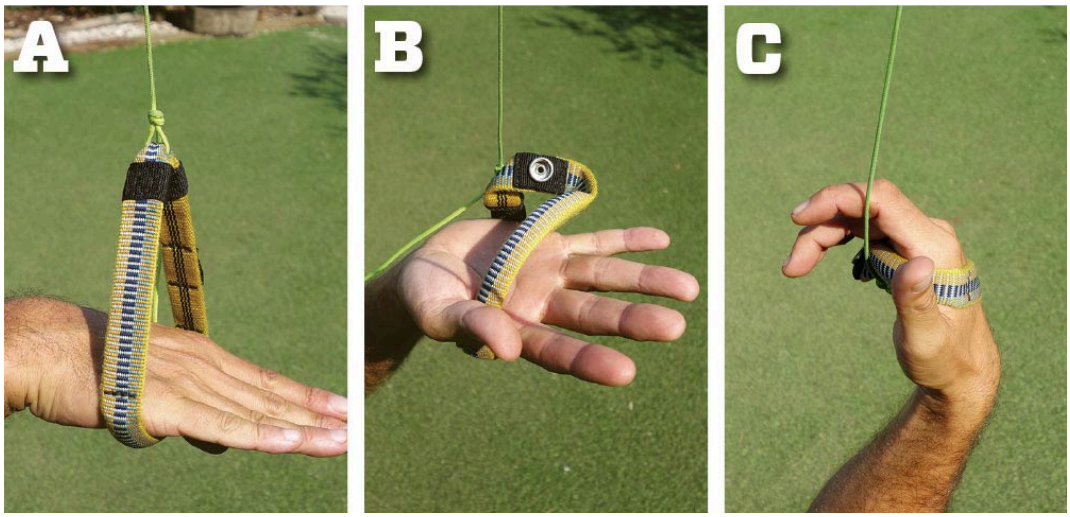
techniques to a sound level in comfortable places before we need them in anger on unfamiliar sites.

Holding the brakes: our connection to the wing

WHEN WE use our brakes, we need a method or technique that truly connects us to the glider's trailing edge. It should be comfortable. And importantly we need to be able to throw the brake handle away easily in an emergency.

There are no right or wrong ways: I feel that there are pros and cons with all methods, but some have more cons than others.

My favourite by far is the **classic half-wrap**, as it ticks all the boxes. It enables contact with the trailing edge, while keeping the hands high enough to 'pull and not push', (more on this later).



THE CLASSIC HALF-WRAP

A. Hand through the handle, thumb lightly gripping the material or 'stiffener' beneath

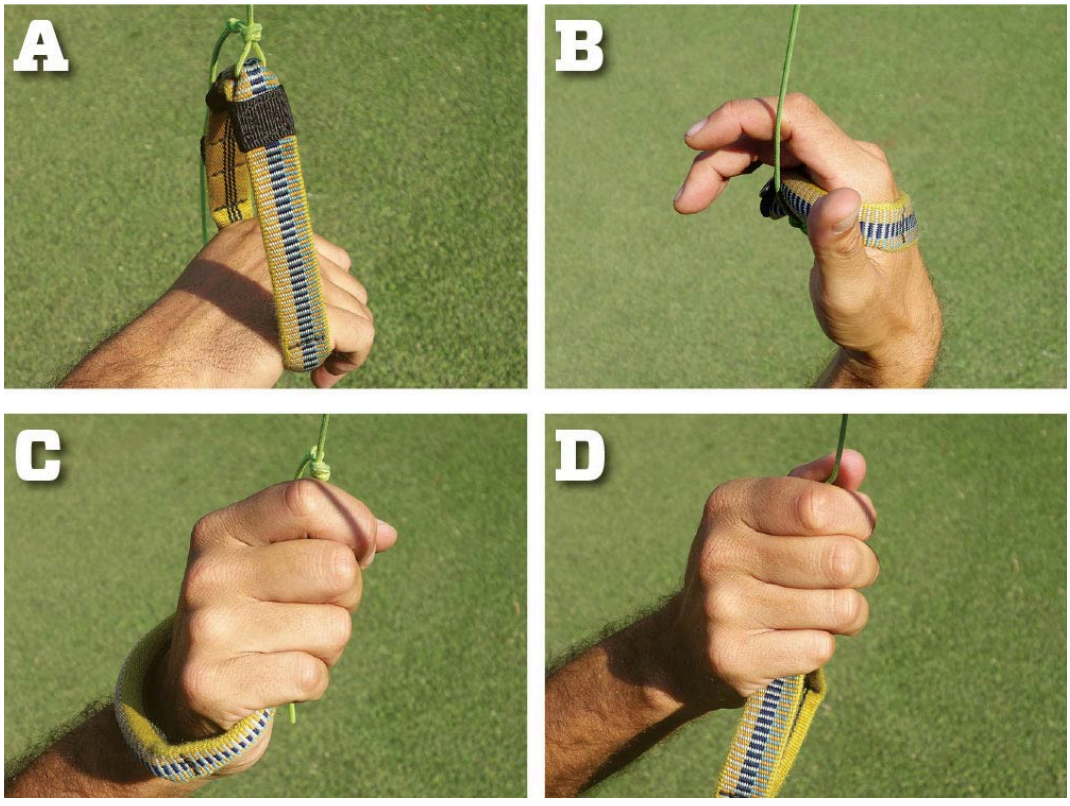
B. Roll wrist outwards, and then inwards and around the line, being careful not to allow the 'stiffener' to slip. Note the handle stays on the meat of the hand and is not allowed to crush the fingers

C. Fingers lightly engage the line, again allowing nothing to slip. For extra sensitivity the line can be bent on the finger, which is known as 'fishing'

The classic half-wrap allows the use of smaller, and so more sensitive, muscle groups, and gives a comfortable yet strong position. More importantly, it can easily be let go of in an emergency.

Once wrapped, ensure the line does not cut into the hand or restrict the circulation. This is a common mistake, and is often the reason why pilots test and then discard this technique. The line should be on the meat of the hand, close to the wrist, and not crushing the fingers higher up. Even the brake handle can be used to lessen the load of the line, spreading it over a wider area.

Something I tell my students is that the smaller the muscle, the better it is for listening. We 'hear' feedback through the only line that we're holding: the brake line attached to the trailing edge. The tension through this line gives a wealth of information. Without listening to this information properly, any reaction can be dulled and out of sync.



HOLDING THE BRAKES

A. The standard grip

B. Classic half-wrap

C. Dragon grip

D. Pinching the line above the handle

Plan for the 'what-if'

Imagine you get a big low-level collapse leading to twisted lines – quite possible with today's higher-aspect wings and pod harnesses. To deploy your reserve the brake handle should be immediately released so that the hand can go unhindered to the reserve handle. That's not so easy if the hand going for the reserve is locked by the twisted lines, as the forces are huge.

This possible scenario alone should rule out using the **dragon grip**, because handcuffing oneself to the brakes could be the final link in the chain of events that turns a bad day into a very bad day.

This hand position is widespread. If you feel that you can remove your hand without thinking about it, then please continue to use it. But if you try to quickly remove your hand and fail because of the size of your gloves or brake handle, this technique should be dismissed as having one major potential flaw. Only you can decide, but be honest with yourself.

Another method is **holding the line above the handle**. There's no reason against this, except that it can lead to fatigued wrists and fingers on long flights. Only comfort is a factor here.

Then there is, of course, the **standard grip**: the simple method of fingers through the handle and pulling down until the brake engages. This is how most people are taught. There's absolutely nothing wrong with this apart from a little comfort and a large loss of sensitivity, because of the muscles being used.

The sweet spot

On most wings, unless the brakes are shortened you may find that the 'sweet spot' in handling is below a 90-degree bend of the elbow, meaning that the pilot is pushing the brake instead of pulling it. We discuss this more later, but for now remember we want to 'pull, not push'.

The sweet spot is the point in the brake's travel where minimum effort provides maximum effect and is where gliders like to be controlled. The use of the classic half-wrap means pilots can turn the glider and control its movements around this sweet spot easily.

Use of the classic half-wrap avoids large, unwieldy arm motions. Instead, wrists and fingers listen and react, in tune with the glider. If

you intend to try it for the first time, appreciate that the brakes will be effectively shortened. That means you'll stall your wing at a higher than normal hand position. So treat it with caution until you get used to it.

As pilots we should be aiming to fly the glider by feedback pressure and not hand position; allowing the glider to fly the way it wants, not choking it with large amounts of brake. It's "What we need, when we need it, for as long as it's needed".

Pilots who've tried this technique usually go on to adopt it for the rest of their flying careers, because without it pilots, and I include myself here, feel disengaged. It's called 'classic' for a reason!

Carving the line: the difference between master and apprentice

HAVE YOU ever noticed how the same pilot seems to climb out when most others are in the bottom landing field? Very often they are the first to launch and yet the last to land, sometimes after flying hundreds of kilometres. This same pilot makes it look easy as he or she carves through the gaggle and then onwards through the stubborn inversion. Hot knife, butter – leaving the less versed behind.

Is it pure luck, or a feeling they are born with? Is it the years of experience, perhaps, or is it really that higher-rated glider? Maybe it's some kind of black magic. Or is it something more conceptual, yet so straightforward that every hobby pilot can master it? You'll notice the word easy is not mentioned.

What are these pilots doing so differently from the majority of recreational pilots across the globe? The difference is very marked, but can be simply stated. They're making fewer mistakes, mistakes that are made universally throughout our tiny but far-flung sport. Positively spun, these pilots could be said to be more efficient, which equates to the same thing and is a common theme throughout these pages.

If we understand the mistakes and learn how to rectify them, there's every chance that, in time and with practice, we'll also be able to climb out effortlessly on these light days, stay up when the sun goes into hiding, and break through inversions like that hot knife through butter.

In this chapter we'll deliberately ignore climbing on strong days, as it requires a lot less technical skill. Pilots who can climb out on the lightest days usually take the strong stuff in their stride. They have a well-oiled, sharp set of tools that allows them to make use of the whole day: from the first light thermals of the morning, through the strongest part of the day and then well into late-afternoon and even evening. Their soft and hard skills have been truly mastered.

To climb out in strong air we need three basic things: first, faith in the passive safety of our equipment; secondly rough timing to hold the nose of the wing open; and lastly nerves. None of these are what I'd describe as skills. These climbs lie at the stronger end of the spectrum; these are the 'hammer' days, when over 200km can potentially be flown in the Alps.

Most pilots, even beginners, will climb up when it's strong and the thermal is wide. It's hard not to; the climb rate forgives even the wildest of moves. "Lean in, just pull the brake and go round roughly in circles," some might advise. As long as the pilot can crudely stay in the large, powerful thermal, he'll appear to do well. But when it gets tighter or weaker, at an inversion for example, the holes in his technique will show. As the climb not only weakens but narrows and is pulled and pushed in directions that are hard to predict, mapping and tracking skills will be tested to their limits.

When we fly in stronger conditions we're exposed to far more risk than when the climbs are light and soft. Master the light end of this spectrum, enjoy its subtlety, and you automatically reduce the risk of the sport by a huge margin. Strong Alpine conditions are best used for long-haul flights, and are not that comfortable for most recreational pilots.

Weaker and narrower conditions require much more technique. More often than not we'll encounter these more challenging conditions, either at the start or at some point in an XC flight. They require what can be described as the soft skills, delicate tools instead of the crude and clumsy hammer. Possessing all these techniques is what truly sets the masters above the apprentices.

How to climb better

So with the above understood, I'll state that there can be only two ways these pilots are physically climbing better. To analyse their über-efficient technique we need to break it down to the basics. They're carving a better line or centring better on the climb – or, of course, both.

Making fewer mistakes increases the amount of height a pilot can steal from a particular thermal. That's important if the climbs are

short-lived.

Let's look in more detail.

The turn or carve

The first thing you'll notice is that the 'surgeon' or expert will commit fewer errors in the way he moves around the sky. He's extremely smooth – very important when the climb is light. It's easy to throw away metres to clumsy errors; the smoother your carve, the quicker you'll climb. You'll never see him choking or diving the wing; he maintains a fluid line as he opens and closes this carve without the penalty of turning height into speed. Potential to kinetic energy is simple physics: remember, energy is never lost, just converted.

The expert has the ability to flow, even in rough climbs. Imagine the pilot acting like a car suspension, a spring that damps out all the bumps, swings and surges. This allows the pilot fluid, constant motion through the air and, more importantly, maintains efficiency. Mistakes in the carve that see us pendulum around, even minimally, can cause the vario to lie. That in turn makes it more difficult to home in on our prey, the core. Swinging around wildly under the wing will cause a loss of altitude and a stronger climb will be needed to gain the same height. So smoother is definitely better.

A good example is to watch acro pilots burn off height on a run. They may link their moves smoothly but would definitely be guilty of converting height to speed as they loop and spin their way down.

The map

This is the ability to place and, more importantly, keep the glider in the strongest lift, knowing instinctively which direction to open up and when to close the carve, finding the core earlier and exploiting it with this smooth, imperfect circling. It's imperfect as no two 360s are identical; we're rarely satisfied with what's on offer, always seeking a higher climb rate.

Thermalling should no longer be thought of as a series of 360-degree turns. Think of this carve as a constant flow around the sky, always towards the stronger core. It's pure analogue movement, avoiding stiff binary actions. It treats every quadrant of the carve

differently from the last, and every degree different from the next. It's reaction rather than anticipation.

So practised are the best pilots at these two things, the carve and the map, that they can appear to be on autopilot. No conscious thought is given to the carve, and eventually, with practise, none to the map. This allows the brain to observe things that are happening outside the one-metre sphere of the risers.

Carving + Mapping = Better observation

Observation is a positive symptom of having these two skills hard-wired, embedded in muscle memory, as an inbuilt timer. Knowing where you are on your carve will allow you the perfect timing to start to open up and hunt the core, taking small calculated steps until you are fully inside.

Observation suffers greatly when pilots decide to fly wings that are too demanding for their level, or to fly when it's too strong for their ability. As observation declines, so does overall performance. This is overlooked by many newly qualified pilots. The straight-line performance of the latest hotship is irrelevant when compared to the loss of the pilot's ability to observe, process and react to events surrounding him, some of them crucial for avoiding risk.

If the pilot's attention is being stolen from the sphere of the risers by what's happening 10m above, it's very difficult to train the basics required – first the carve and then the map. Comfort is highly under-rated, and a pilot who is free to think will perform better than one constantly under fire.

This is stressed elsewhere in these pages, and is one of the keys of successful XC flying. Once a pilot's observation is compromised, it's tough to react to events happening in the 1km sphere around the pilot. He or she may fail to notice clues to better climbs nearby, lurking leeside activity and even other traffic.

This has a knock-on effect, and soon the ability to plan solid moves down the 10km cone out front is drastically reduced. All the extra performance potential a pilot gets from that latest XC machine is lost as this discomfort interferes with an XC pilot's true secret weapon: observation.

As you read through the book it's worth remembering that the following techniques are designed for the lighter 60-70% of the thermal spectrum; as I've said, strong, large climbs forgive mistakes. However, the more efficient you can become in the technical stuff, the better your balance and timing will be in the strong stuff. It's a win-win situation.

The black art of thermal flight

WHEN you learn any ‘black art’, it helps immensely to break the skill down into its separate parts. Each one is important, and so is the order that they’re learned in. Trying to run before you learn to stand never helps.

As I said in the opening chapter, the goal is to do as much as possible on autopilot. That leaves bandwidth free to make decisions that are sometimes crucial to staying airborne.

Learning to thermal properly is a basic skill, the cornerstone of XC flight. The sequence should go something like this.

- First, turn the glider at the desired radius then learn to do it smoothly. Without the correct radius, our smoothness throughout the carve, as we open and close the turn, is irrelevant. Only when the correct bank and timing of the carve are achieved, even if they’re messy, can efficiency be improved.
- Once the radius of the turn is correct, it’s time to make it as clean as possible. Maintaining energy throughout the carve is vital, while keeping it as smooth as possible.
- When this perfect, imperfect circle is in hand, the practice of moving it around the sky comes into its own. It’s not so important to get the angle of opening 100% right in the beginning, but to do it smoothly. The vario won’t lie, and it will be easier to find the core. By opening the turn or simply releasing the inside brake, we’ll be moving our 360 in the right direction – the start of mapping and homing in on that core. It’s vital, but only once the carve is clean and is being done without the use of too much thinking power.

Cleanliness is next to godliness, someone once said, and the cleaner the carve and the ability to move it, the better we’ll be flying. Forget the godliness for the moment.

These are the three steps to learning to thermal, and they should be practised in this order, moving on to the higher level only once

the previous one is in hand. Progression is easier if learning follows the correct sequence.

This will lead to the linking of smooth turns, and will allow a flow around the thermal. Once a solid technique is honed, we should start to think about linking climbs; after this we move on to route planning, which will be a later chapter. This is the syllabus we've used on our courses over the years, with great success.

Introducing the concepts of flow, efficiency and good technique

Later I will try to explain a means of physically carving efficiently and with feeling. The aim is to allow pilots instinctively and accurately to place their wings in the right part of the climb and, more importantly, keep it there.

This is the technical difference between expert and hobby pilots. When these techniques are mastered they'll enable pilots to use even the tightest or lightest of climbs.

Thermalling well is all about the flow and efficiency of the turn. All things being equal, the pilot who climbs best will be the one who makes the fewest mistakes. This is even truer when you include the next step: mapping. Flow and mapping, which are covered later, are the most fundamental of thermalling concepts; without either of these, one can expect poor results.

Technique in thermalling is important. Any pilot who thinks that burying the inside brake is a valid technique should stop listening to stories of bravery on a windy hill and start to think about the consequences of such clumsy actions. Dogs and pirates bury things; we should not. Burying the brakes usually results in showing the more skilled and subtle pilot the top of your wing.

To return to our metaphor, consider your overall technique a bag of tools. On some days, in some thermals, you'll need a sledgehammer. This is when the air is rough with you. Be a mirror to the air; give back what you get. If the air shouts at you, shout back with control. But don't expect for a moment that this heavy technique is a one-size-fits-all method.

Trying this on light days or when breaking through stubborn inversions will see pilots often land frustratingly early, or get stuck. This is when your precision tools are required – micro-screwdriver, say. As the air whispers to us, we should gently whisper back. Sometimes on light days I dare to breathe only slowly in case I break the spell; it's absurd, but flying sometimes feels that subtle.

The more sharp tools we have in our bag, the more we can deal with what nature decides to throw at us. It may be just hanging on in a strong leeside thermal, where holding the nose open is more crucial than the perfect carve, or it may be squeezing the best out of that last climb of the day to get home, when it helps to home in accurately on the core. Which technique is required depends mainly on where the climb lies on the spectrum. One end is technical, the other strong.

It's vital to train with all the tools to be a well-rounded pilot, but unfortunately pilots who train only in one place or one kind of conditions will find it hard to adapt to other, more subtle thermals.

Pilots who train only in wide and strong thermals are always the first to suffer when things get tricky (tight and light) despite the number of hours they've flown. Their first assumption is that the site or thermals are no good – many pilots refuse to look in the mirror or criticise their own technique, even though other pilots climb out day in, day out on the same chessboard. It's not luck but technique.

Understanding what makes a day technical

Narrow thermals, weak conditions, inverted air or all of the above. Add wind into the mix, and you have a very trying day. Climbing out on these days requires the pilot to understand the concepts of turning and mapping efficiently, not to mention good tracking skills plus a degree of luck. And it's often better to be lucky than good, although pilots who possess the necessary skills are often luckier than most. Coincidence?

Different thermals require different levels of skill. Tight and light climbs are obviously going to be more challenging than wide, strong thermals. The more technical the climb, the more technique is

required; I've said it before, but it's one of the most important statements within these pages.

I've also said that everyone comes up when it's strong. Imagine a thermal that's over 300m wide and has a strength profile of between 2-5m/s. At trim speed it will take almost 30 seconds to fly through it. This is what I would describe as technical level 1. The equivalent of shooting fish in a barrel.

An average climb in the Alps, or anywhere for that matter, could be 80m wide and about 2-3m/s, depending on time of day. So 7-8 seconds will see you fly through this one. This I would say has a technical level of about 5 – average.

Technical level 10 is the hardest, perhaps because it's very light (0.3m/s), so any heavy-handedness could see the sink rate of the carve increase to something that this weak climb will not support.

The main reason for its technicality would be that it has roughly the same radius as our carve. Perhaps it's just 5m wider than your turn at any given side. That means that if you open the carve for more than half a second in any direction, you could fall out. You might find this scenario near an inversion, where only the strongest part of the thermal fights slowly through, or close to the ground during a low save as the air struggles to leave the terrain.

This can be as tough as it gets, unless we add some wind or the climb is being moved around by layered stability (inversions). Wind can tear thermals apart, making your usual search patterns and strategies ineffective. Inversions can squeeze and push thermals, again making them hard or almost impossible to centre on.

Inversions can halt a climb's vertical development or seriously slow it down. It's not uncommon for a technical level 5 to become a much higher number as it approaches a layer of stable air.

Learning to track

This is where high-level mapping turns into tracking. Tracking is a skill where we are no longer only searching for the core, but trying to stay with it as it's squeezed sideways through the air. So not only are we trying to find the strongest part, but the whole thing is moving. We're trying both to stay in and to search, usually at an

inversion or on a windy day. This is the highest level of the thermal skillset, as the carve needs to be perfect, the map needs to be accurate, and the feeling is as subtle as it gets, telling us at which point we need to open and close, and for how long. It’s extremely difficult to put into words what we’re doing when tracking. However, once a pilot understands and can achieve this concept, they have reached a very high level of skill.

The golden rule of constant cadence & smoothness

ALL PILOTS who can thermal well adhere to an important rule, although most won't even know it exists. For competent pilots around the world it's instinctive, intuitive, even obvious. But it may need explaining to those who don't understand the subtle concept of what binds all good pilots together in the first place. This common theme is called the Golden Rule.

Simply stated, the Golden Rule says: "However their wing moves, the pilot shall keep their own body's progress through the air as smooth and constant as possible." Their reactions under the wing must act as the spring that irons out the bumps, surges and swings that may cause an inefficiency in the carve.

The pilot should have a constant cadence throughout the carve, and obviously through the air. Even if the wing above is moving at different speeds (on any or all of the three possible axes), the body underneath, ideally, should not undergo any increase or decrease in speed. Any sudden changes felt by the pilot that are induced by a lack of smoothness will cause, via gravity, height to be converted to speed. That's not ideal if we want to climb faster.

Every time a pilot swings through when changing the radius of the carve, some altitude can be lost. Control the smoothness of the carve and you'll gain more altitude in the same time, achieving a better average climb than a pilot who's often breaking the Golden Rule. This is not nearly so important when the climb is strong, but the difference will be noticeable when it is weak.

It's not possible to be 100% smooth 100% of the time, but just understanding that smoothness in light climbs is essential is more than half the battle. Pilots who can carve clean lines through rising air and centre on the climb efficiently will do better than pilots swinging through and blundering. The latter is not a valid technique, by the way. The less a pilot breaks the Golden Rule, the better that

pilot will climb. In fact this rule encompasses all aspects of flying efficiently, from entering thermals to gliding fast in rowdy air.

Large dives and pendulums when climbing are very costly because of the time needed to get the wing back to level flight, which you have to do before entering a smooth carve again. All this, together with wild movements under the wing, will cause the vario to be inaccurate. This leads to the next problem: mapping.

It is really as simple as that, but again I'll never use the word "easy". The following sections will cover these concepts which, when practised, will enable subtle and sensitive pilots to carve truly beautiful lines around these invisible currents of rising air.

Ideas for better techniques

The Golden Rule demands that we maintain a smooth cadence through the air. Regardless of how choppy the air is, it's vital to have the ability to carve around the sky, 360 by 360, without a noticeable change in speed.

We discussed how the pilot should be the suspension to remove unwanted bumps and surges. This carve should have a constant feel about it. It will rarely be a perfect circle, because of our constant mapping. But if it wasn't for our unrelenting search for a stronger climb rate, the circle would be as perfect as they come.

Now let's look at some of the common mistakes – the enemies of the carve.

Common mistakes

Sit on a busy hill long enough and an attentive pilot will notice several things. One group will make it look incredibly easy; another will seem jerky and a little uncoordinated, and may struggle to climb out.

We know now that the pilot who climbs out effortlessly time after time is making fewer mistakes, but let's look more closely at what those mistakes could be.

There is of course the **breaking of the Golden Rule**. This is one of the most serious faults that any pilot will have to address in all

aspects of efficient flying, although it's not the only enemy of the efficient carve.

Turning too wide is the most common mistake seen on hills around the world. This is easily remedied by the simple four-seconds-for-90-degrees (4-for-90) rule (coming up in detail later on). The main reason is that we want to put the turn inside the climb, and not fly round or in and out of it.

Another common mistake is **the swing through**. This normally occurs when too much inside brake is applied and no outside brake is used to rein in the energy. This is felt as a large increase in airspeed on the pilot's face, accompanied by a small feeling of G-force. This is the classic breaking of the Golden Rule; the extra speed was the result of converting height into speed.

The final mistake on the list is **not keeping constant energy in the carve** – allowing the glider either to straighten up or to wind in. Either way the system is broken, and level flight must be achieved before it can be restarted. This can show itself as either a series of 180-degree dives, or the wing winding into a light spiral dive. Either way the energy was not controlled. More care needs to be taken to maintain a constant flow: that's the Golden Rule.

The concepts that bind good pilots together

JUST AS pilots who thermal well are bound together by the Golden Rule, these same pilots are bound together by a set of concepts. These concepts allow pilots to carve clean lines and move those lines around the sky – and, most importantly, to do it without penalty. The penalty, of course, is converting precious potential energy (height) to unwanted kinetic energy (speed).

These concepts are common among pilots who thermal well, even if they don't know they exist. That's because if they don't abide by these concepts, the Golden Rule is surely broken. It goes without saying that if a pilot constantly breaks this rule, he will not climb effectively; he will therefore not be a good pilot, in this instance at least. Never mind how much fun he appears to be having, efficiency is what we're looking for here. It's a matter of black and white.

So the following concepts help to maintain our smoothness. Any breaks can be traced back to one of the concepts. They work for all levels of progress. My style is my suit; it won't fit all readers, but with these concepts we can tailor our own suits, and make our own styles. What makes a strong, valid style in the long run will be that it remains true to the Golden Rule.

These concepts are known as the Big Three.

1. Keep it smooth

Maintain roll, pitch and yaw. Control of all three axes is crucial if we want to respect the Golden Rule.

Roll is controlled by balancing, using core strength to keep the risers in the configuration that we choose, not just allowing them to wildly rise and fall. The earlier we react, the less we have to react. Keeping the karabiners in the position we want with minimum movement will stop lateral breaking of the Golden Rule. This allows us to maintain the energy and direction of the carve.

Pitch control is simply the idea of keeping the wing above the pilot and loaded. Wing loading is crucial to stability; large forward pitch movements will be closely followed by large pendulum motions of the pilot, turning height into speed.

Yaw control is about maintaining efficiency without choking the wing. It takes practice to instinctively understand how much outside brake to use, how long to use it for, and the tempo of application. This is critical to stopping the outside shoulder from dropping in, which is also followed shortly by a pendulum motion. Apply too little and the wing will surge; apply too much and the cadence of the pilot will slow. The wing, starved of airspeed, will pitch forward to regain what was choked out, and the resultant swing through will break the Golden Rule.

Think of your hands as controlling two different aspects of thermalling. The inside hand controls mainly the direction; it governs when to open and close the line, as you hunt the core. The outside should be thought of as the efficiency hand – floating the outside, reining it in just enough but never choking it; always letting the wing fly.

All three axes are important, but yaw is the one that can really make or break our flow. Balancing all three is crucial to becoming an effective and safe pilot. Pitch control will see the pilot ward off many potential front stalls and asymmetrics. This is the essence of active piloting: our balance.

Keep the glider above your head. Don’t allow it to wander, because the next step will be a swing through, converting precious height to speed. That’s not so important when it’s strong, but crucial when climbs become technical.

2. Be analogue: listen and react, don’t anticipate

Your arms should be loose and relaxed to listen to the wing and react instantaneously, with no jerky movements. Every input should flow to the next, especially in light, technical air.

Lock nothing; avoid binary input. Try not to hold on to the risers, and don’t put a thumb into the karabiner; that’ll take away 50% of

the control possibilities. It's certainly nothing to do with being analogue.

Try also not to lock the weightshift on. Strong weight input (85% plus) is valid at some times, but not all the time. Analogue pilots should be more flexible, using only what's needed, whenever and for as long as necessary. It's difficult to be flexible if weight or another input is welded on. Remember, be analogue.

There are a billion-and-one shades of brake and weight configuration. Most may be valid at some time, but to use just one all the time is not what we're after here.

Remain loose but firm in the harness. Loose to listen, firm to react. Maintain your structure and maintain your chosen configuration, whether gliding or carving.

If you're too rigid, you're sure to lose sensitivity and conditions will seem rougher than they really are. Too loose, and you'll be bullied by the air and unable to react with correct bodyweight inputs. I often recommend pilots shake their arms during the harder midday hours. The result is often less jerky control inputs as the pilot starts to react in real time, rolling with the punches.

3. Pull, don't push

Use the right muscle groups for the job of listening and reacting. Smaller muscle groups are better suited than large ones to determine how much pressure is present. That's biomechanics 101 (see also the chapter on holding the brakes).

Using the classic half-wrap allows sensitivity with control of the wing. This is crucial when listening to brake pressure and wing feedback, so that correct input can be given. Without it, we'll lose out when we need it most: in light technical climbs.

More weight, less brake

An important idea to take on board is to use slightly more weightshift; this enables pilots to use less brake for the same degree of bank and turn.

Some experimentation is needed though, as this will allow the glider to be flown slightly faster, giving better handling and more

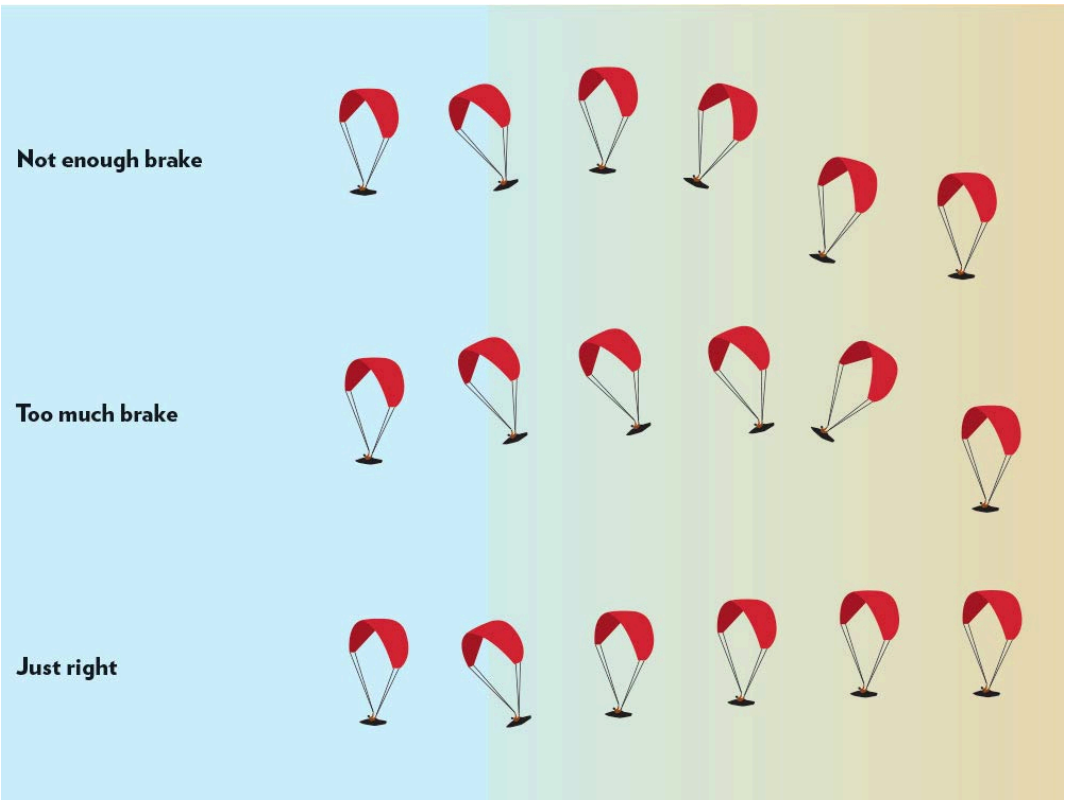
internal pressure. A pilot who uses this extra dynamic throughout the carve will do better than one slowly yawing the glider around the sky. Internal pressure also makes the wing more tuck-resistant. Play with the physics here.

These concepts will allow pilots to start to craft a style that remains true to the Golden Rule. It takes time and patience. Now starts the fun part, the training. Thermalling well is the cornerstone of all XC flights. Without it we are doomed to failure, or reliant on luck and ‘hammer days’.

Entering a thermal

FROM FIRST encounter to the first turn, through to a dynamic carve, thermal entry is a vastly overlooked set of skills. When you're low in light lift, it can make or break the chance of climbing out. The most important aspect of the entry is, as usual, compliance with the all important Golden Rule.

Anyone can burst into a climb, wildly pull a brake and go round in rough circles. Not everyone can do it cleanly and without penalty – which is usually a net loss in altitude, or even just an inaccurate instrument reading. Again, the lighter the climb, the more important the entry. As I keep saying, everyone comes up when it's hoofing. Only sensitive pilots come up when it's light. Jerky or non-linear control inputs will see the pilot swing around. That's not ideal in light lift. Everything should be smooth. And technical conditions require pilots to own a technique. The toolbox must be full of well-oiled and sharpened tools, from the hammer to the watchmaker's screwdriver.



ENTERING A THERMAL The correct amount of brake must be applied at the right time, and for the right amount of time. When brake is not applied for long enough the pilot will swing through; too much and they will choke the wing

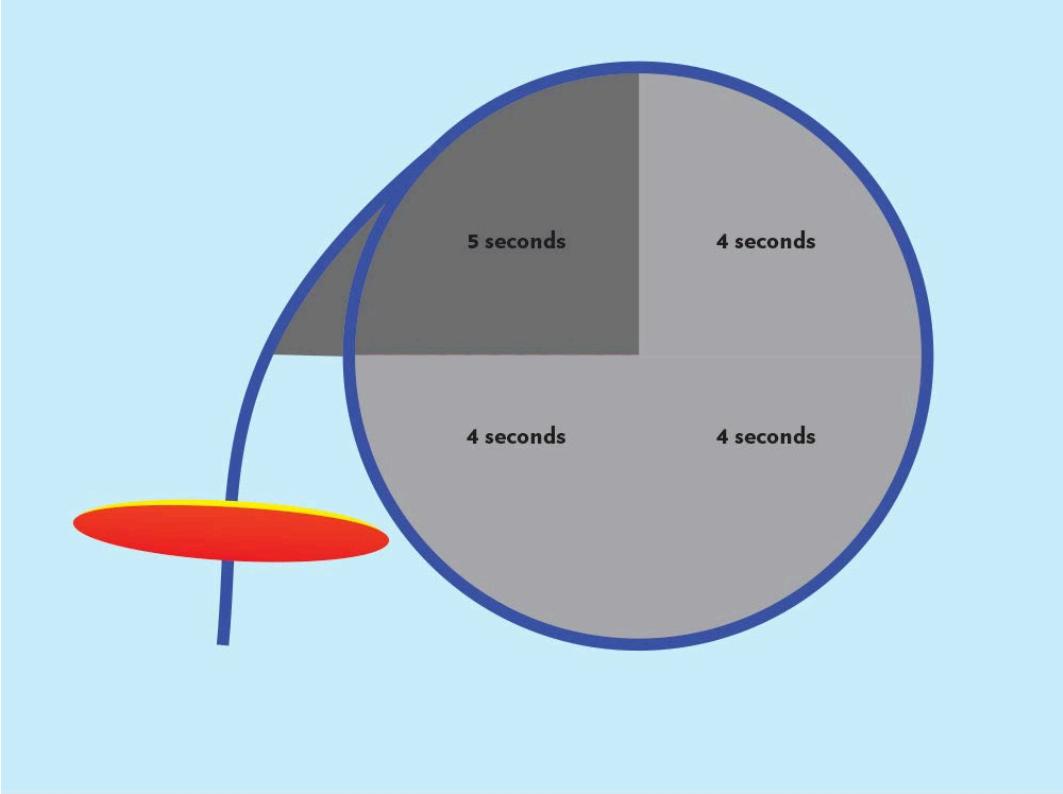
The first encounter

Depending on thermal strength and glider type, the wing will do one of two things to a greater or lesser degree. It will either bite forward or get pushed backwards. The former usually happens with higher rated wings, and a pilot can 'steal' energy from this reaction by slowing the glider down; how fast an input depends on how fast the wing pitches forward. Remember, be a mirror to the air: if it shouts at you, shout back. If it whispers, whisper back. If this scenario happens, you'll usually find an increase in altitude straight away.

If the glider's knocked backwards, the pilot can do little about it except wait. The wing needs to be above the pilot's head, moving forward with the right energy, before a turn can be induced. If the timing is wrong, the Golden Rule is sure to be broken. Too far behind, and the wing will surge forward before it settles into the carve. Too far forward, and the pilot will again swing underneath and vast amounts of outside brake will be needed to rein in the extra energy. Both scenarios will convert height to speed.

As the glider approaches 90-degrees overhead the correct amount of brake must be applied – not only at the right time, but for the necessary amount of time. This is very important. When braking is not applied long enough, the pilot will swing through. Applied too long, and the wing will be starved or choked of airspeed. This means that when the brakes are raised again, the glider will dive and the pilot swing through, breaking the Golden Rule.

Only the correct timing, quantity and duration of input will stop the pilot breaking that rule. Each situation will be different, but the process is the same. Sometimes it happens asymmetrically, or with induced roll too. This is probably the hardest thing to cope with when entering a rough thermal, and it's where being loose to listen and firm to react really comes into its own. Balance and reactions are key to smooth thermal entry.



INITIATION OF THE CARVE When we start thermalling the initial quadrant takes five seconds to fly. Each subsequent quadrant takes four seconds. The next full 360 should take 16 seconds to complete – giving rise to the 4-seconds-for-90-degrees rule

The first 360

You've probably heard or read a thousand times: when you hit lift, count to four then initiate the turn. This is very simple and still extremely valid. Four seconds equates roughly to 40m. Pilots have asked me in the past how I know whether it's worth turning or not. My reply is always a little cryptic. In general you can feel whether a climb has energy, or whether you're being dummied. It should feel solid, and the wing is often given a 'pull'. Bubbles and turbulence feel lightweight by comparison. The more often a pilot feels this subtle but sometimes obvious difference, the less he'll be dummied, saving time and precious altitude on wasted 360s. That said, sometimes a climb that's just starting or ending will give a similar feel to simple turbulence. In this case, experience is everything – sorry to cop out here!

If after four seconds things still feel good, a pilot should feel which way the thermal is leading him by the analogue concepts of the big three. Choose a side and smoothly roll into it, using the hips. As the desired angle of the risers is reached – I find here the default setting is the pilot's nose in line with the risers – the inside brake should be pulled (not pushed) by no more than 5-10cm per second. It should be noted that when using weightshift, the hips should be at 90 degrees to the spine; weight shifting is not weight slouching. This requires core strength and balance. It is a sport, after all. Pilots will notice that when the body has correct alignment and structure, less 'slumping' is required to change the configuration of the risers or more noticeably the karabiners.

The first 90 degrees of the turn should be completed in about five seconds with every subsequent 90 done in four seconds. The reason for the slower entry is obvious, as paragliders are quite inefficient things, and every time we sharply change direction we are potentially awarded with a swing-through and a loss of altitude. Smoothly tightening our turn is one way to avoid this. Obviously if the climb is tight and strong we can afford to be a little more clumsy in the entry to either the climb or, more importantly, our carve.

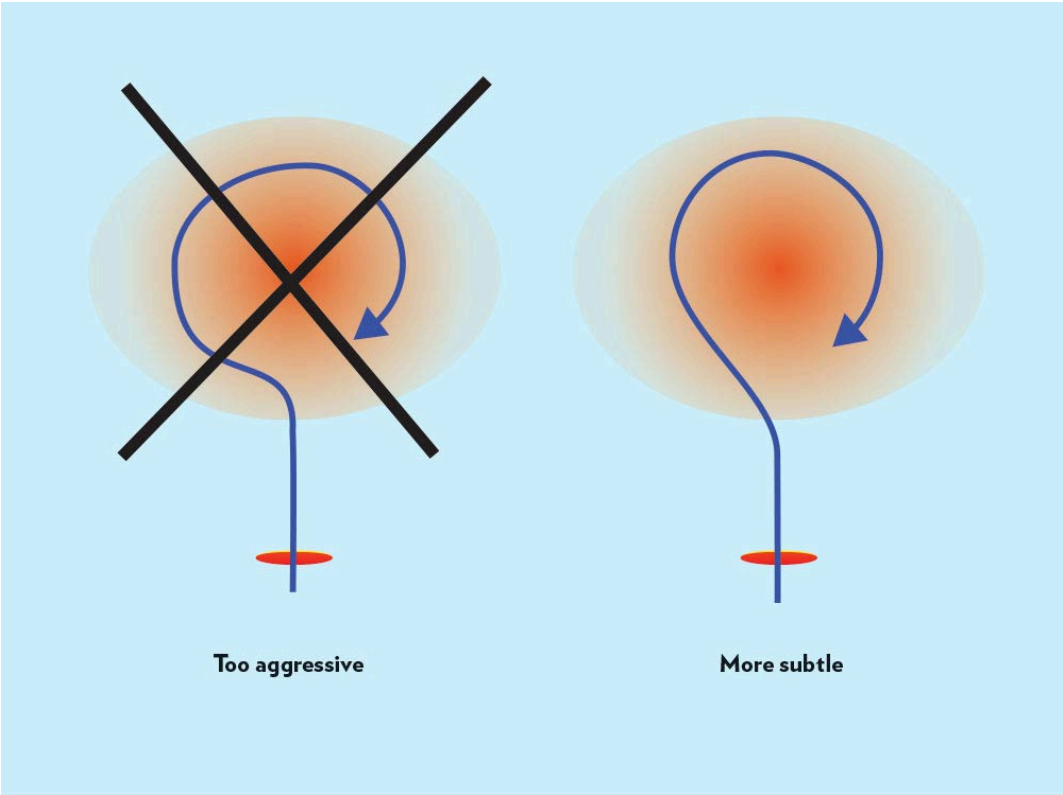
As our wing starts to carve in the desired direction, we'll need to stop the nose from dropping in. This can be achieved mainly by the correct timing, amount and duration of input – sounds familiar – of the outside brake.

Think of the outside hand as the efficiency hand and the inside as the mapping hand. The inside will mainly control the direction, letting a pilot correctly open and close the carve to move the wing around the sky, while hunting the stronger climb – mapping. This is coming up in the next chapters. The outside hand is there to stop the pilot swinging through too much, thus maintaining our smoothness.

As I've said, the less often and less brutally the Golden Rule is broken, the better the pilot will climb. It really is that simple. Learning to carve clean lines without a conscious, clumsy thought process is what makes thermalling the black art that it is.

Once the pilot is in a smooth, four-seconds-for-90-degrees carve and is happy, the climb is worth investing time in. It's time to start to map the climb, in effect moving this smooth, pure motion, this flow around the thermal, in ever smaller increments until the pilot is satisfied, gaining as much height as possible.

This thermal mapping or centring is higher up the progression pyramid, mainly because the mind needs to be clutter-free to concentrate on where the stronger lift was felt. That's impossible when the pilot is still consciously reacting, stuck in the 1m sphere. Without having the carve – this true, smooth, 4-for-90 flow – somewhat embedded in our muscle memory, accurate mapping is irrelevant.



TURN REVERSAL As the pilot enters they turn left, then turn right. When using the turn reversal technique it's important not to be too aggressive. A subtle drift left (in this case) before turning right is far more efficient than cranking the brakes

Turn-reversal technique

This is the practice of turning one way then the other when first encountering lift, normally when a pilot is unsure which way to turn

as they hit the climb pretty much head-on. Although it's a valid technique, something needs to be stressed here. Changing direction quickly is a surefire way to lose height. As usual, if the climb is strong it will forgive and possibly even support this lack of efficiency. To swap weight wildly will see a kind of wingover; great for height loss, but not subtle enough for light climbs.

In this situation I use a slight 'side slip' when using the turn-reversal technique. I keep neutral or minimum weight input to one side and slow that side down considerably to drift into the climb. Then I slowly roll my weight to the opposite side as I gently release the outside brake while squeezing on the inside.

This is far more subtle and works well. However, if the climb is both light and tight, be careful not to drift too long as you could find yourself falling out of its front. Once you have made a full 360, it's time for the mapping strategy to take effect.

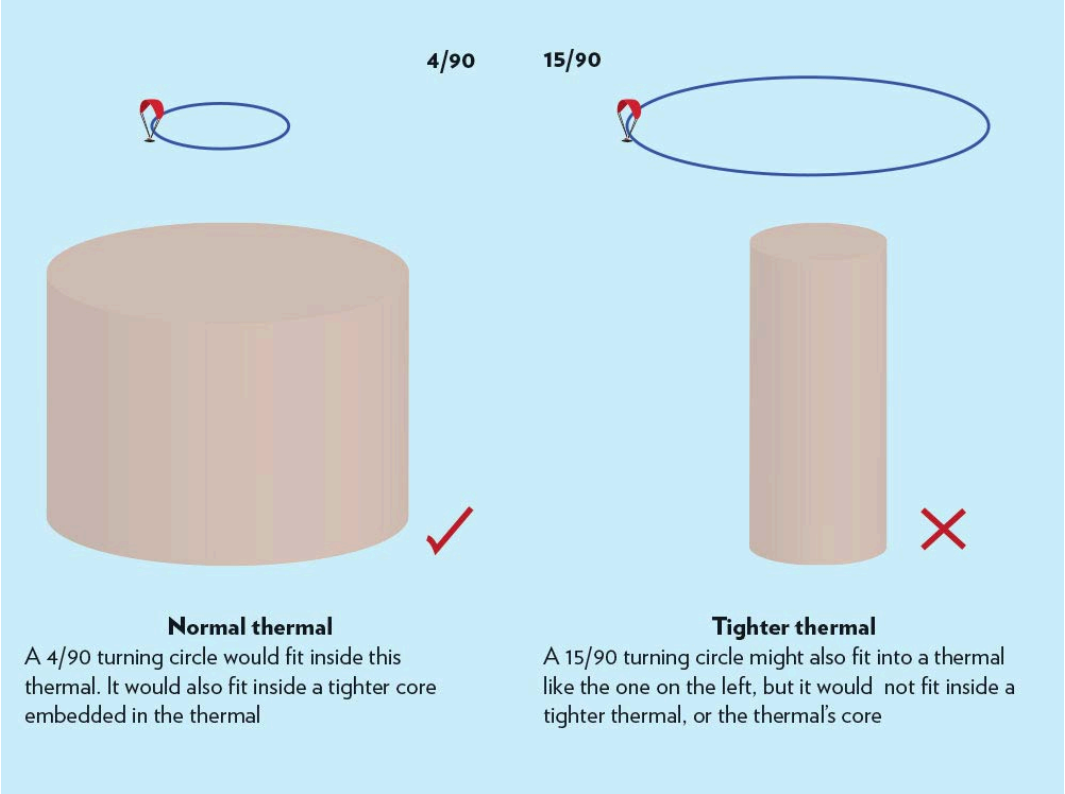
The ‘4-for-90’ rule and why it works

IN 2009 I made a long flight, mainly on autopilot. The aim was to watch what I did when, and more importantly its effect. This one flight led to drastic changes in the way I’d go on to coach pilots, crystallising many techniques and concepts that make up this book.

Over the years I’ve been asked countless times by pilots how tightly they should be turning. An answer given in metres was not only irrelevant but unhelpful; I don’t even have a number to quote, as we don’t have tape measures or laser pointers up there.

There had to be a more conceptual yet direct method. During this important flight it dawned on me that my 360s took a consistent 16 seconds to complete. This was a true revelation.

Distances were irrelevant, but everyone can count. Sixteen seconds to cover all four quadrants; even simpler, four seconds per quadrant or 90 degrees showed the correct radius was related to this turning speed. Soon afterwards, the 4-seconds-for-90-degrees rule of thumb was created. This went on to produce some very powerful results, as the main enemy of the carve is a pilot’s inability to turn the wing through the correct radius.


4/90
15/90
Normal thermal
A 4/90 turning circle would fit inside this thermal. It would also fit inside a tighter core embedded in the thermal
Tighter thermal
A 15/90 turning circle might also fit into a thermal like the one on the left, but it would not fit inside a tighter thermal, or the thermal's core

PUT THE SAUCER ON THE PLATE When thermalling we need to 'put the saucer on the plate', not the plate on the saucer. We want our turning circle to fit into smaller thermals, and be able to take advantage of faster-rising cores inside wider thermals too.

Why it works

The important idea of turning 90 degrees in about four seconds simply stops pilots from making far too wide circles. That's a common mistake in the early days, as pilots are drilled at school to use small inputs (and rightly so).

When we're trying to climb, the sink rate of our gliders is very important. Turning too steeply for the amount of lift available will see pilots lose out and the vario stay silent. Too wide, and pilots will bumble in and out of the climb, although the sink rate may be lower.

When thermalling, we wish to put the saucer on the plate and not the plate on the saucer. By that I mean that we want our turning circle to fit into smaller thermals, and especially into the core. When we turn too wide we are either outside the climb or in and out of it.

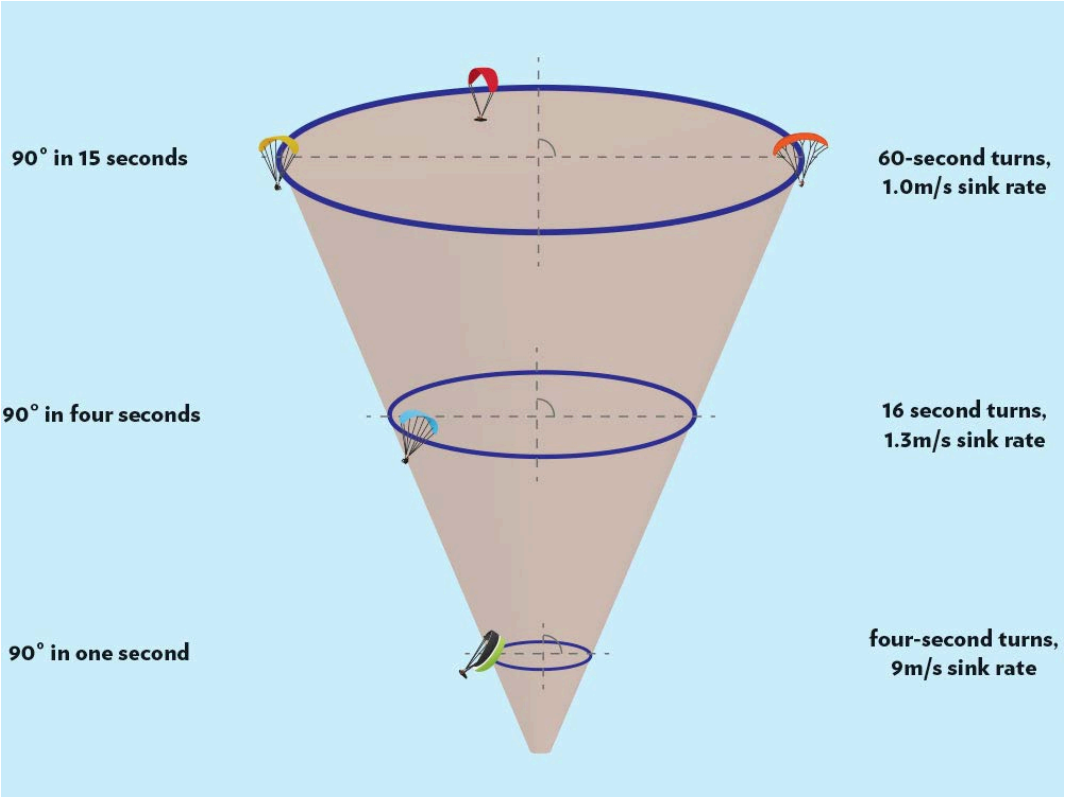
Turning too tight also has its penalty, as I've said, so there must be an optimum turn radius by which our sink rate is not

compromised too much by the ability to put the saucer on the plate, figuratively speaking.

So imagine the turning circle as an ice cream cone, the turn rate being the circumference. At the widest part the sink rate is low, but the turn is very wide. Close to the point, the turn is too tight leading to an extreme sink rate. So logic tells us that somewhere there's an optimum turn rate. And for modern average-sized gliders (M) that happens to be four seconds for 90 degrees. That's as tight as possible without a punishing sink rate. When practised it also feels very natural.

Also, if the climb is small and the turn rate wide, we'll fly in and out. But if we turn tightly without a sink-rate punishment, we can try to fit this circle into any climb that could be useable.

Mapping climbs is basically just moving with a solid strategy our imperfect, ever increasing, ever decreasing circle – or the carve – around the sky. This is the art of mapping, or simply centring efficiently in on the climb.



THE TURNING RADIUS ICE CREAM CONE Imagine the turning circle as an ice cream cone, whose circumference is your turning circle. The sink rate is low at the widest part but the turn is wide – close to the bottom the turn is too tight and the sink rate (9m/s!) too high.

The exception to the rule

The only time the 4/90 doesn't really help is when the climb is large and uniform. That means that the thermal from edge to edge is the same; wide enough to stay in but without any increases in climb rate. This mainly happens at the end of the day; sometimes there are very wide climbs with cores that are few and far between. Here it's better simply to reduce your sink rate to the bare minimum and keep a smooth turn going.

This is the only time that searching and carving tight lines won't help your cause. It's better to just relax and join the smooth carousel of other wide-turning pilots.

I've done no maths on the subject, but I would guess that if you did stumble upon a solid core in this uniform climb, going back to the 4/90 would soon see the wide turners looking up at the underside of your wing.

Another time that the 4/90 should be surrendered is if there's another pilot in the way. The 4/90 rule is not air law. Please be sensible and go around the back of the pilot. If his carve is inefficient, his turn too wide and his ability to map non-existent, it won't be long before you see the top of his wing, so be patient and at least give him a chance. He may actually blunder into a nearby core and help the cause of the gaggle.

Homing-in on the core

IN CROSS-COUNTRY flying, as we follow the flow over our chosen chessboard, we make decisions akin to chess moves. But before we make our moves we must earn them; only by gaining altitude can we have options. First, carving clean lines helps to gain as much height as is efficiently possible. We also earn our moves by spending as much time as we can in the strongest part of the thermal. This is done by homing in on the core.

This is the next step in a pilot's technique, and must be preceded by learning the lower level, carving, to a fair degree of proficiency. This will allow free bandwidth of concentration to be devoted to working out where this stronger part of the climb lies. I'll describe a specific strategy for centring in on our prey, the thermal's strongest part. Master this, and XC flying will start to be a challenging game of skill, no longer reliant on luck.

Good pilots also maximise their chances of getting up on a tricky, technical day, or even finding the way through an inversion far overhead in the first few turns. Why?

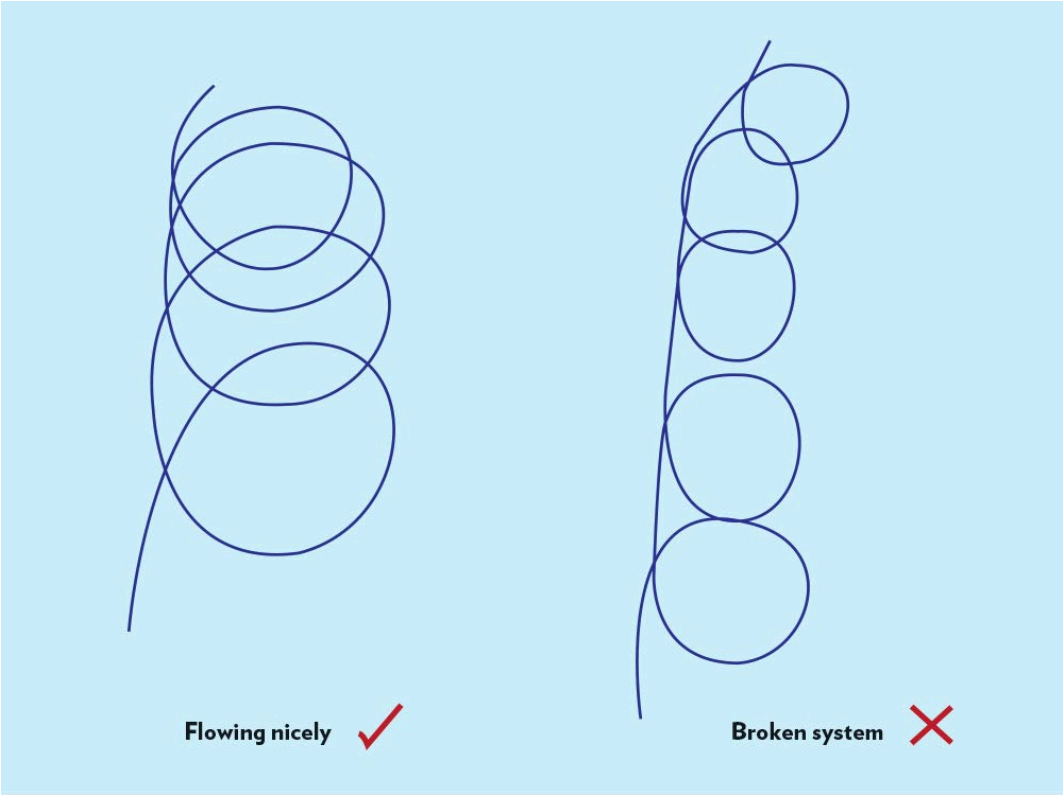
It has a lot to do with a pilot's ability to home in on the core and quickly. The strong heart of the climb is the part that will get through any layered stability or inversions. Centring on it will see pilots not only climb faster but also be at the right place when the thermal breaks through, a very important skill set.

After carving comes mapping. This progression will enable pilots to stop swinging around under the wing and blundering about the sky without a strategy.

We should by now understand that pilots who do well day-in day-out are carving cleaner, smoother lines. They're respecting the Golden Rule, and have the ability to move the imperfect but perfect circle around the sky, without the penalty of turning height to speed. Their smoother turns enable truer readings from their instruments too; this is vital for mapping. It may also be clear by now that material plays a very small part in this ability.

So we've grasped that being able to place, and more importantly keep, the wing in the strongest part of any climb will see pilots climb faster. The ability to open and close the carve is crucial – not only smoothly, with correct timing, but also in the desired direction. The difference between surgeon and butcher here can be as little as a 15-25 degree switch in direction. It's not long until these small differences add up to a height advantage; another difference between the master and apprentice.

These are the key concepts needed to promote a fluid motion that flows around the climb, penalty-free.



MOVING THE CARVE Opening and closing while keeping weightshift on allows the carve to flow in the right direction, and not be just a series of 360s linked by straight lines. Opening the inside brake for two seconds sees you travel 20m

The price of admission

We've discussed thermal entry and the carve. Think of these as a system that has a price of admission. The price for entering this flow is a potential break in the Golden Rule. But once this system has started, it's better to keep the momentum going, keeping the energy

in the carve. Repeatedly stopping and starting it is very inefficient and will lose you height. Try to think of the carve while you're mapping as one constant motion, not simply a series of 360s. It's an energy-efficient, smooth and constant flow through the air, not a series of dives separated by straight parts and pendulums. By now this concept should be clear.

The next part is made simpler if pilots have done a lot of clean 360s, understand the 4/90, and can carve without thinking too much about the Golden Rule or the Big Three. The carve should by now start to dwell in muscle memory. Mapping or centring sits higher up the progression pyramid, because it requires some degree of processing power to act on the constantly changing information. Mapping works only when the stronger part of the climb is attacked cleanly, adhering to the Golden Rule; otherwise little advantage will be gained.

When carving the line inside a thermal, you'll usually be rewarded with a higher climb rate on a certain section of the 360. Rarely is the climb rate constant throughout. As you recognise which direction the core lies in, it's time to move the carve in that direction – albeit a general direction in the beginning. With experience and practice the core can be fixed on with a higher and higher level of accuracy. Now, though, it's important just to maintain the 4-for-90 in the same direction.

To extend the carve into the strongest section, we should slowly open it by smoothly releasing the inside brake, the mapping hand, for about two seconds. This moves the carve about 20m in that direction. At the same time as opening the carve with the inside hand, we need to maintain our desired amount of weight-shift. This is really the key, subtle though it may sound.

By moving the carve small amounts, we can flow around the sky; nothing breaks the flow more than a break in the Golden Rule. Centring one's weight in order to fly only 20m straight breaks the system, the flow; it requires that pilot to pay the price of admission again and again. That's inefficient. Once the flow has started, keep it going. Stopping and starting the system will see pilots needing far more outside brake than is really necessary. They'll be practising

damage limitation instead of a constant, smooth motion. It's far from easy, but nothing worthwhile ever is.

Move the carve in small increments unless there's a sign that further away it's going better – a bird or glider climbing perhaps, or just sitting under an obviously large and active cloud. I usually start at two or three seconds (20-30m) per opening in the beginning, then once I'm closer I usually open for one second (10m); once I'm in the core and almost satisfied I'll give small half-second inputs (5m).

However, if you see someone 50m or more away climbing better than you, break the system and start it again when you get there.

This system is just a guide to help pilots carve something that would look more like a telephone cord that flows around the sky, and not a series of wide polygons joined by straight bits with intermittent costly dives. There's a huge difference!

Opening the carve cleanly and in the right direction for the right time will see pilots climb faster and more efficiently than those who blunder around the sky with macho brake-burying antics. The inside, mapping hand should be opened and closed no more than 5-10cm per second. Slowly open, slowly close. Usually this technique will require a little input from the outside hand, the efficiency hand of the system. This prevents unwanted yaw or pitch that will break the Golden Rule and cost precious altitude.

The weaker the climb, the more strictly you must comply with the Golden Rule. Remember, stronger air forgives the mistakes of the more heavy-handed pilot. This is what separates weekend warriors from the Alpine cracks, this and the smooth motion of the carve.

Some definite don'ts

Don't change direction. It's very inefficient, not to mention clumsy, to crank the opposite brake and change your turn direction. It'll induce a wingover and almost certainly break the Golden Rule, causing the vario to give an inaccurate reading, not to mention the height loss.

Don't centre your weight. Stopping weightshift, unless you want to glide some distance away, will break the flow. Constantly applying

and removing weightshift will see pilots pay again and again the price of admission. Once in, stay in.

Don’t bury the brake. Pilots sometimes think that hitting the core is a valid time to bury the brake. Doing this usually sees the pilot swing out, through and down. I’ve been guilty of burying the brake and it usually means applying about 4-5cm, sometimes a lot less, of inside brake around the sweet spot.

Remember, the sweet spot is where minimum effort has maximum effect. The glider should be flown often around this point. Learning where it lies on your wing is vital to finding the sensitivity to fly in all conditions.

Wildly pulling brakes is not to be recommended. Remember to be a mirror to the air, shouting when needed – with control – and whispering gently back in softer air.

Mapping strategies

HERE ARE three strategies designed to help pilots centre on the climb. All three use the basic concept of maintaining weightshift, while slowly opening and slowly closing. They rely on pilots having a good understanding of the basics of the carve.

Imagine making a statue from a large piece of wood. These techniques can be thought of as increasingly detailed woodworking tools. The first would be the chainsaw, cutting the log into the basic desired shape. The second is the chisel, to start making a recognisable likeness. The third is sandpaper, to finish by smoothing the sculpture.

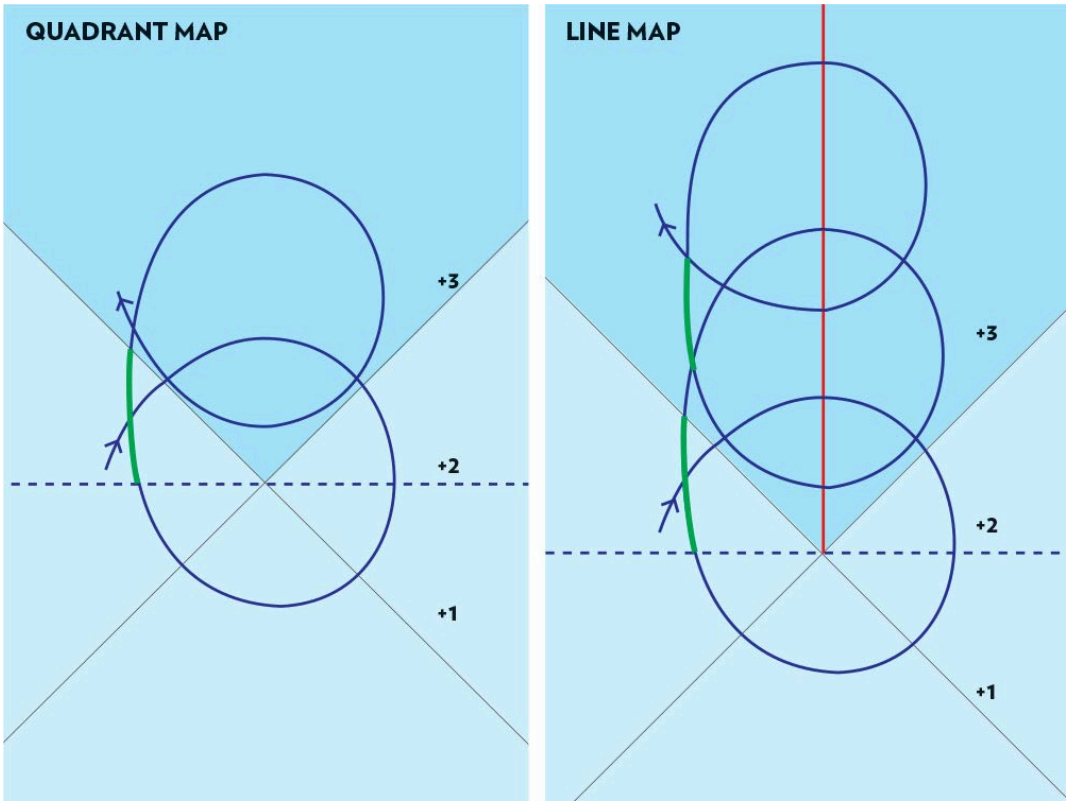
The pilot's level of understanding and experience will dictate which of the three should be employed. Think of them as beginner, intermediate and finally advanced ways of doing the same thing.

1. The pantomime map:

'It's behind you!'

Once you've initiated your carve and tightened it up with the classic 4-for-90 rhythm, you may feel that one side of the thermal has a stronger climb rate. Remember which side. Needless to say, it's on that side, over there, and not this side, or over here. Knowing "it's behind you" will give you time to anticipate when to slowly release the mapping hand or inside brake to move the carve crudely in that direction.

Again, do it for two or three seconds in the beginning and most definitely while keeping the weightshift on. That's the most important aspect of smoothly moving the carve around the column of rising air. This is the most basic method, and one that should be mastered before moving on.



THE QUADRANT AND LINE MAP APPROACHES

In the Quadrant map the darker blue quadrant is where the strongest part of the thermal is felt. The green section of line is where the pilot uses weightshift-only to open up the turn slightly, before reaching the quadrant of strongest lift. The Line map, right, is an extension of this strategy. The precise line of strongest lift (red), in the middle of the strongest quadrant, is sought. How early or late the pilot opens up the turn (green section) is the trick.

2. Quadrant map

This is similar to the rougher pantomime map, although we're now starting to home in to a greater degree. Instead of splitting the carve into two crude halves, we now start to feel which 90-degree chunk rewarded us better, hence the name: the quadrant approach.

Once a pilot has ascertained which quadrant the stronger climb lies in it's time to introduce the next level of complexity into the timing. We still keep the weightshift on – that part rarely changes – but now comes the finesse of when to open up.

If the pilot opens exactly where he felt the strongest part, in the middle of the quadrant, then because the weightshift is maintained,

the carve will slowly orbit away from the strongest section. This is mainly due to the angle of bank and turn, which is kept even though the brake's been slowly disengaged.

More appropriate is to open slightly before facing the centre of the quadrant that you intend to search or move your carve towards. This enables you to move your carve efficiently down a line towards the strongest part of the carve, effectively homing in on the core. And again it's important to open only for short periods, 2-3 seconds to start with. Then once the pilot is mainly in, reduce the motion to one second and finally half a second.

Opening too early or too late will see the pilot bounce off. Learning this timing is crucial to staying true to the map. After a while it becomes automated, like adopting the Big Three (p55) into muscle memory.

3. Line map

This is similar, but instead of quadrants we now hunt the line to the strongest part. The search refines from half to quadrant and now to a direct move towards where we believe the core to lie. It's just a continuation of the same strategy; this time the line will be in the middle of the quadrant. Understanding where this line points will tell you where you need to open on your next orbit. How early or late to open down the line is the trick; this makes or breaks this technique.

This next level of complexity regarding when and how to open includes the angle of bank, or strength of climb. This has more to do with timing, and is more advanced to get right. The more steeply you're banked, the earlier it's possible to open. As with the previous strategies, timing is everything. Even the rate at which the carve is opened can be played with extensively.

Experiment, and soon there'll be no reason why anyone will outclimb you. This is the true difference between the master and the apprentice. It's playing with high-level physics.

All aspects of thermalling are important: the radius of the carve, respecting the Golden Rule, maintaining energy. What is described here is the final component that allows pilots to exploit the strongest part of the climb for the longest duration. Together with a strict

adherence to the Golden Rule it’s the reason why the same pilots climb out time and time again on days that seem to have almost no thermic activity.

This is the real soul of our sport.

Thermal etiquette and gaggle flying

SUCCESSFUL XC flying, and to some degree just spinning up in the house thermal of your local site, requires teamwork. Teamwork is only possible if the other pilots in the gaggle trust you, and vice versa.

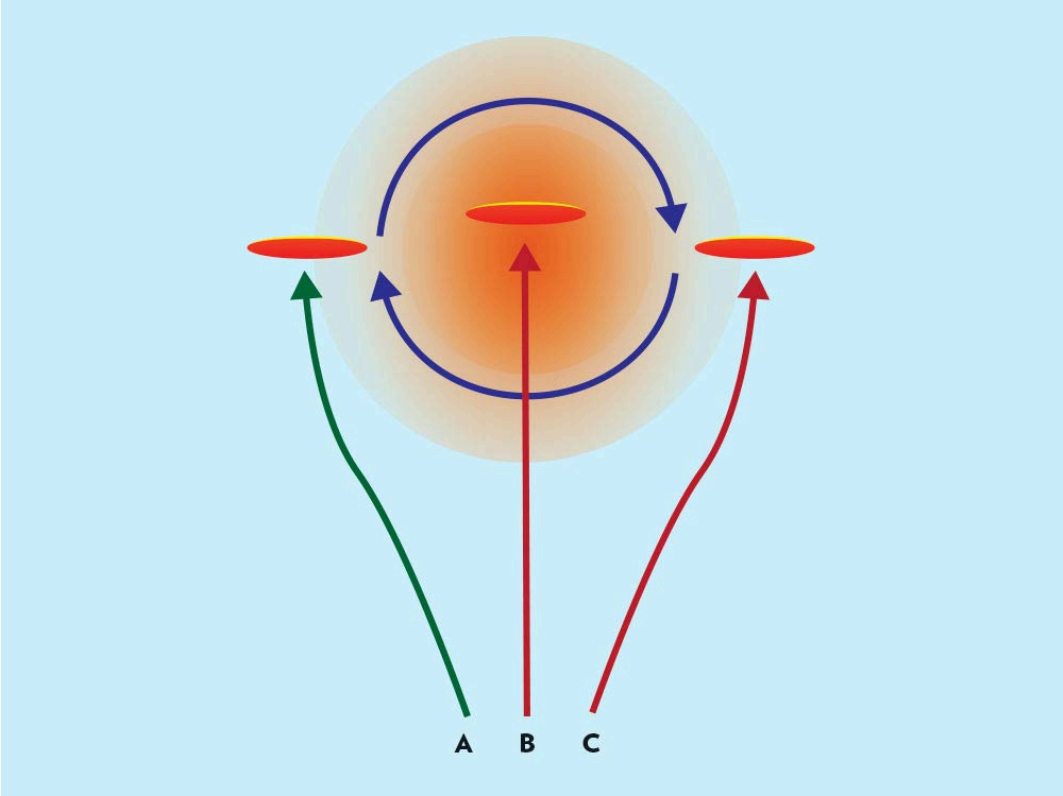
A pilot's entry into a thermal, when others have found the climb first, can instantly build trust or destroy it. Trust is very important when flying your glider close to others. Mistrust of other pilots, their intentions or their skill levels does nothing for the energy and fun factor of a gaggle.

It's very reassuring when an approaching pilot respects your line while you're busy marking the climb for him. Then instant trust and mutual respect leaves the gaggle's collective mind confident that its new friend will be predictable and understands closing speeds. This means you can leave the climb to search for the core knowing that there'll be very little conflict when you rejoin the thermal if the search proves fruitless.

Also, pilots are more than happy to share the rewards of a stronger climb with someone who helped them find it, even if that means only that he allowed them to carve their line without any major changes on his entry.

Experienced pilots can usually see a conflict cropping up just by the line that someone is taking to join the thermal. This is not so important if you're joining higher or lower in the climb. But, at the same altitude, it's vital that a pilot shows which side of the climb he wishes to join.

My advice here is that the guys going round in the climb have full right of way, and my respect. We should not disturb their rhythm at all, but join ours with theirs. This is easier than it seems, much easier, as it's mainly to do with point of entry.



THREE WAYS TO JOIN A GAGGLE: ONE RIGHT, TWO WRONG

Pilots in the thermal are turning in the direction of the blue arrows. Option A is the safe and correct way to join: joining behind a pilot, or where you saw the back of their head. B is the bowling ball line: flying straight through the gaggle won't make you popular. C, the face-to-face attempt to join against the flow of traffic, is also dangerous.

Etiquette of entry

Let's look at the three different ways of joining a thermal, and the reactions that each will draw from the group. Of course, this is irrelevant if you're alone or you find the climb. In that case you'll be thankful when others stick to the etiquette of entry.

The bowling ball line

Usually a beginner's mistake. Nothing builds distrust and contempt for a fellow pilot more than this poor attempt at joining the thermal. It consists simply of flying straight through the gaggle, not even choosing a side to enter, then desperately trying to carve a line through the scattering pilots.

It's extremely dangerous and inconsiderate, and will quickly alienate the pilots in the gaggle. Most experienced pilots will see it coming, shake their heads, take avoiding action and then climb away anyway thinking: "What is that idiot doing now?" Not good for the dynamic or morale of the gaggle. Not only is it disrespectful to the other pilots, it also offers very little chance for the joining pilot to climb efficiently. Because the thermal markers are disturbed, this pilot now no longer has a steady stream of accurate information to work out where to open or close next (although those concepts are usually wasted on pilots who use this 'technique').

The core is also now bisected, and a turn in any direction will see this pilot fall out of the core or the thermal. This is even more crucial if you're low. A big mistake like this can put a gaggle down instead of making a low save. I would hate to be the pilot responsible for that!

There is no reason to do this irritating, dangerous and unfortunately widespread practice. It shows that the pilot is not aware of closing speeds and has insufficient regard for his own safety and that of others.

Bottom line: Do NOT do this. Period. It's bad for the health of everyone around you, including yourself.

Face to face

This is another startling method of thermal entry that I've witnessed many times. After the bowling ball method, this is the most dangerous and inefficient way to enter a thermal.

Usually a pilot is seen heading towards a right-handed thermal (pilots are turning right) but stays on the right-hand side of the climb, like a child trying to get on a roundabout whilst the other children are coming towards him. After one or two bounces the child would start to understand the concept of closing speeds – but we can't afford bounces in the air.

Pilots facing each other have a closing speed of roughly 65km/h, or 20m/s. In five seconds two pilots who were 100m apart are on top of each other. This is the main reason for mid-airs. No one got hurt colliding with a closing speed of 3-5km/h. Aiming at the side of

the thermal where you see pilots coming towards you is generally a terrible idea.

There are two main reasons: first, the closing speed is high, and you'll earn the mistrust of the other pilots in the gaggle. And secondly, once a pilot is on the outside on the wrong side of the thermal, i.e. where he has pilots on his inside coming towards him, he now has only one way to join the thermal properly. That's to fly away, make a turn and join where he sees the back of the pilots – which he should have done in the first instance. You'll lose height to the gaggle every second. It's impossible to join efficiently once you join the wrong side. This pilot will never catch this gaggle or benefit from the information it could have given him.

It's often very painful to see a pilot come face-to-face joining a climb, and then see that there's no way in. So he keeps going down and around the outside of the climb until either everyone has passed him, or again he flies away and tries again. It never ends with this pilot gaining on the gaggle – never.

The correct and safe way

We all know, or should know, that we go round the same way as others in the climb. It was in the exam, and makes sense. However, in school nobody told us a simple rule about thermal entry etiquette. So here it is:

Always join the side of the thermal where you see (or where you saw) the BACK of the pilot's head.

If you stick to this simple rule you'll never have a conflict in thermals. It's that easy.

Everybody on the ground understands the rules of the air. But under fire in strong conditions it's no surprise that pilots find themselves making small errors of judgement. So keep the rules simple and easy to remember when we need them the most, until they become second nature. Finally, show your intent early. Don't surprise pilots, be predictable and keep an appropriate distance from each other.

When and how to close the turn on another pilot

If there's room, if it's safe to do so and you feel the pilot on the opposite side of the climb to you is not exploiting the core well enough, it's acceptable to close your turn tighter. But youmust be 100% sure that you will gain an advantage from this potentially aggressive manoeuvre.

If a pilot safely cuts in and shows you the underside of their wing, take your hat off to him or her (wait until you've landed), but if an aggressive move shows you the top side of their wing, you'd be right to shake your head.

Just ask yourself: will you gain from it? If not don't bother; just hold your line. Look and feel for a time to get the jump. If you're right and your thermal partner is weaker at mapping than yourself, you'll find the moment to overtake, if that's your plan.

If I wish to overtake a pilot who I feel isn't fully exploiting the climb, I'll map as best I can, wait for him to make a mistake and then close on him. Usually we'll drift apart if his or her mapping and observation skills are lacking. If not, then he's in the core with me. Once I see the chance I will close my line and soon be looking down at the top of our friend's wing.

But if the pilot is good, he won't be making mistakes. Any inefficiencies in the map will be quickly rectified, and the 'cut in' line will be blocked. When a pilot is either not mapping correctly or often breaking the Golden Rule, it won't be long until a good pilot will lose him anyway. Mistakes are compounded, remember.

But even a beginner will give a wealth of information about the air around him. All pilots are potential thermal markers; it's just that some help you out longer than others, depending on their relative skill level.

Gaggle flying

Nothing in free flying is as rewarding and bond-building as gaggle flying: making new friends or travelling with old ones, moving as one over the terrain, taking turns to lead out.

Flying as a gaggle can increase your search area, especially in the flatlands, raising your chances of finding climbs on tricky days or giving a turbocharged feel to a strong day. It's a win-win. That's why

thermal etiquette is important. It means we can experience this safely and without paranoia thanks to our predictability.

Sometimes I like to compare gaggle flying to antelopes crossing the Serengeti. Occasionally after a long glide the gaggle needs a low save and, just like in the nature documentaries from those wild plains, one of our friends will dirt – succumb to gravity, the lion of flatland flying.

It's sometimes desperate and sad to lose friends like this, but the gaggle somehow survives and moves on. I've witnessed this a lot, and experienced it myself; either leaving behind an old friend as the gaggle is drawn slowly towards the trigger point, barely daring to breathe, gaining 50m, losing 40m, bubbling along until we escape the hot clutches of the blanket of superheated air. Worse is when multiple pilots dirt; things seem truly desperate then.

And I've watched frustrated from below in a hot dusty field as friends struggle and drift away until the hot spot finally yields, watching them climb away in the relative cool, bitter disappointment intensified by a sweaty repack and hot walk out.

I know which one was more tense, but this is part of the game – it's natural selection at work. The higher the level of honed skills from the last few chapters, carving and mapping, the less often pilots will find themselves lion fodder, and the more easily they can stick with the gaggle. Perhaps, before too long, the gaggle will be looking for them to take charge!

Staying up!

GRAVITY IS the great leveller – although some pilots avoid it longer than others, flying long distances or just staying up when things get tricky. We understand that technique here is everything, but let me briefly cover the basic concept of why pilots go down. Putting a positive spin on it, I've called it 'Staying up!'

Unless the sky completely shuts down, pilots rarely go down by making just one mistake. It's all too often a series of errors. The main difference between recreational and very experienced pilots is the lack of mistakes that they make.

These include: not launching at the right moment (observation); failing to carve efficiently; failing to map thermals and choosing sinky lines over the terrain (route planning/adaptation).

When they're flying XC, the experienced pilots often realise that they've made an error and recover quickly before it's too late, changing lines or even the whole route. Their alarm bells will ring sooner and they'll have a plan B in mind: this is pure route adaptation.

An inexperienced pilot will usually make a series of mistakes. These are rarely addressed until he reaches a height that would require supernatural powers to recover from.

Beginners go down because they don't possess the techniques that will dig them out of a series of mistakes, leading to that stressful low save. Advanced pilots own those high-level carving and mapping techniques, but rarely need them because they realise earlier the error of their ways – a very cruel paradox indeed.

Going against the flow of the day can put pilots down prematurely. Only strong climbs, high bases and a heavy foot can fix this flagrant break in the concept of free flight. Light climbs and gliding at trim into headwinds will see little to no progress before gravity claims another victim.

When you arrive at an important part of the flight and things aren't easy, it's tempting just to push on. But a question mark should be flashing above your head. Rarely does it pay to attack a crux in a

route low. Investing time here is often crucial, as perhaps even a couple of hundred metres can make the difference between avoiding the sink in a lee side and cruising over it.

The flipside is also true about not squandering time, but this is more to do with increasing average speeds around a chosen route. It's nothing to do with staying off the deck.

Of course, the sky may really shut down and go beyond technical level 10, or pilots may just miss the less than abundant climbs, but quite often the problem is that they can't use the lift that's available.

Launching at the wrong time comes from not watching the sky. Observing and understanding what's happening over your shoulder is everything.

Then there's making a move out of frustration. We must earn a move before we can make a move. A move made with insufficient height, especially if a crux, can make the day even harder, because the pilot will find himself even lower. Strong moves and some discipline are needed.

Breaking these and other efficiency rules can put pilots on the ground. In the beginning it can be useful to imagine a question mark flashing not just above your head but on your cockpit. At every decision it should flash, and flash harder if a big move is about to be made.

Flashing is its way of asking: "Will this move put me in a bad position? Could I go down?" If the answer is yes, then rethink that move. Either earn more height or observe the chessboard – the sky and landscape you are in – longer before committing.

Getting down quickly and safely

THE PREVIOUS pages have looked at how to climb efficiently. Now what if you need to do the opposite? Forward planning and strong early decisions will beat the best ninja moves that a pilot has in his box of tricks, but life doesn't always go to plan. Sometimes we as pilots overcook a situation, leaving things a little too long, and we need a solid 'down' solution.

Thinking a little bit ahead can reduce a lot of the stress in these situations. Using the later discussed 45-degree rule will usually keep us from disappearing into the white room, even on the strongest days. Watching cloud development, and the location of large clouds if we're flying in a valley system, will encourage safe and timely decisions.

Nevertheless, the most common scenario is one where a pilot finds themselves getting dangerously close to a cloud. In this situation pick a heading, preferably away from terrain and towards the nearest exit or patch of blue, and fly straight, with big ears and speedbar.

I would not recommend a heavy spiral here, because you'll most likely just get drawn into the strongest part of the climb. I would not recommend a B-line stall either – it's outdated and not effective. If the wing is flying, we should do our best to keep the status quo. Stalling the wing can cause problems when releasing. Twists have been known to happen from a slightly unevenly released B-line stall.

A second and more dangerous scenario is getting caught out by a gust front. Getting down safely is the most desirable outcome, but if a pilot is nervous about a potential downburst of cold air or rain from a large cloud nearby, landing on high ground, away from the shallow, cold outflow, is a better and safer option. However, landing before a gust front is important if a pilot doesn't want things to get out of hand very quickly.

In this situation we break all the rules of efficiency. Apply big ears and speedbar, sit up or stand up to project a large area into the airflow, and lightly roll from left to right to induce small wingovers.

This technique, called ‘falling leaf’, can give quite a high sink rate. Always do it upwind of your landing zone. A spiral or B-line stall will see pilots lose a lot of ground to the wind and have potential problems – unless the ground is totally flat everywhere. Each situation calls for a different technique. But once you’re in a strong flow lower down with limited landing options, it’s often better to use the falling leaf, in order to hold your ground. Remember: the earlier you decide to go down because of a change in conditions, the less frantic you’ll get and the more control you’ll maintain.

Route planning

WHAT I HAVE to say in the following six chapters is fundamental to the making of a solid plan. It can mean the difference between flowing safely over terrain at a good average speed, and getting stuck, landing early or, worse, experiencing at first hand the dreaded rotor of the valley wind.

This has nothing to do with the wheres and whys of thermal development, nor even lines to take over the terrain; that's discussed elsewhere. But it has everything to do with the day's air mass and the way the sun's heat is allowed to interact with the terrain, which in turn interacts with the air in contact with it.

These techniques can help reduce mistakes when flying – and remember, the fewer mistakes you make, the less performance you need. Then a relaxed pilot can concentrate on the chess game at hand.

Route planning in the Alps

It's very common and understandable for non-Alpine pilots to be overwhelmed by the scale and complexity of flying paragliders through the Alps. The sheer size of the naked rock walls can intimidate even the most experienced flatland pilots.

Planning routes around this maze of peaks and valleys can be a delicate process, both challenging and potentially confusing. Yet by understanding a relatively simple set of concepts we allow ourselves to move safely around this chessboard – following natural flows, never forcing moves, protecting ourselves when danger lurks, even if the unforeseen happens. But to execute these routes with any degree of confidence or success, a pilot must possess the cornerstone of XC flight: thermalling.

Without the subtle skills of carving and mapping, a pilot will always need to fly in conditions that might lie on the stronger side of what could be called fun. These are the hammer days. Without understanding the where and why of thermal development, this same pilot will rely on luck, not judgement.

It’s worth saying again that another under-rated fundamental of XC flying is choosing the right glider. A real increase in a pilot’s performance is achieved mainly by being relaxed, with the ability to observe the surroundings. The basics must be fully dialled in, as if on autopilot, freeing the mind for the long game ahead and not relying solely on the performance of the material. Too many pilots these days are addicted to comparing performance stats.

Only when two pilots are of the same high standard will any material advantage in their gliders start to show itself, as these two pilots will make very few mistakes in their carve, their thermal map or the lines that they take over the terrain. Only then can one truly see the benefits of that extra climb, glide, handling or speed that pilots so often daydream about. None of it, by the way, comes for free; extra performance always comes with a cost to in-flight comfort or even passive safety.

Remember, true performance comes from the monkey hanging beneath. A solid EN-B wing on a good line to a good source will beat a high-end D on a bad line to nowhere, every time. We’re not drag racing.

Clear thinking

It’s both fun and rewarding early on in your career to set routes and have a crack at completing them. But at some point a pilot needs to admit their shortcomings and train the basics to a higher level. This will pay dividends when a route needs to be adapted under fire.

Having the ability to think clearly about the way the atmosphere is interacting with the topography could mean the difference between success and failure, between avoiding and exposing yourself to risk, between being in control or relying on the passive safety of the machine. This is why glider choice plays a huge part, as a pilot’s attention needs to be extended to 10km or more around him, not only 10m above. And flying in conditions that call upon the glider’s passive safety is not advisable for pilots of any level.

Planning solid routes is pure methodology, although it’s thought of as a highly complex skill-set. Adapting the route relies on having the thermalling skills embedded bone deep. The mind, free from clumsy

thought, then allows a smooth set of unconscious reactions, competent and precise.

With this in mind we can discuss the rules of the game. As with the concepts of carving and mapping, there's a simple strategy to planning successful, but more importantly safe, routes around Alpine valley systems.

Predicting the system

The Alps are made up of valley systems, and like all systems they have predicable patterns of behaviour. On any good XC day a similar pattern sets up. When a pattern is predictable it's easier to trust the outcome of a decision; we need things we can lean on when we plan routes. True trust is the opposite of blind faith.

Apart from flying fast along lifty lines, keeping the wing open in rowdy air and not getting stuck en route, what else are the Alpine cracks doing to fly such long distances? Most of it comes from having a solid plan, and the rest from impeccable route adaptation (we're deliberately ignoring the pilot's technical thermalling skill here).

The real finesse, however, comes from the lines taken over terrain and under clouds and the speed at which they fly, knowing when to invest time and not to squander it by climbing unnecessarily. These are extremely high-end skill-sets. But never underestimate a pilot's ability to stay out of trouble, especially low down – of which more later. First let's look at following nature's flow.

The flow of the day

DURING the sun's slow procession across the Alpine sky, we know that east faces will be first to receive the warmth of the day, followed in turn by southerly slopes and finally the west-facing inclines. As these faces are heated over the day, they pull in the hot air in the valley bottom. This warm air is released – and useable by us – from different faces at different times throughout the day. This is what we call the flow of the day principle.

We can use this understanding of the flow of the day to our advantage, to fly longer, easier and more efficient routes through the mountains. Logically, a route that uses southeast faces in the late morning, followed by south faces around lunchtime, and ends up running west-facing ridges in late afternoon will be a better idea than launching on a cool westerly face at 10am. Such a route is surely doomed from the beginning.

A strong route will include as many warm faces as possible, and that will depend, of course, on time. (When planning, understanding your average speed will help you work out where you should be at any given hour.) You might have to make a valley crossing or two in order to follow the sun, and crossing may cost altitude, which could in turn put you at the mercy of what lurks in the bottom of all valleys on any good XC day, the valley wind.

Go with the flow

When planning routes we need to lean on predictability. One predictable element to flying in the mountains is the valley flow. We need to understand which direction this flow is moving, so we can use it to our advantage.

For example, getting home. By late afternoon any route should include sections that will go with and not against the valley flows in the area, if at all possible. If low, a pilot can then drift with the valley wind along flush faces until the thermal is forced to release.

This could take some time and many kilometres. It's very frustrating if the flow and thermal drift are taking you further and

further away from your goal. But if you plan your route correctly then every turn will get you closer to home.

In this situation you will be more inclined to go with this flow and less tempted to leave the climb to search for something better. In the past I've used this technique to cover 15km along a ridge until I met an into-wind spur that enabled me to get out of the flow and continue on my way, at altitude again.

Long-haul flights involve flying until late, using light evening thermal activity. It's very smart to plan to have a last section that enables you to drift and bounce home. How satisfying it is when you're tired to let the flow do the work for you.

Planning and flying routes this way will ensure that you follow the path of least resistance. This is a common theme with all soaring craft, and the less efficient the craft, the more important these rules.

Gliding against valley flows, even when in orbit, can be tricky. Once in a while you'll get low, lose ground and potentially end up back where you started, especially if the flow is strong. You may also be pushing into areas where the valley wind could be tumbling. Nothing pulls surrounding air down quicker than a lee side, and turbulence is then sure to follow.

If any route has an into-wind (valley flow) section, that can be considered a crux in that flight, and may be much more technical than the rest of the day. If possible, take extra care when dealing with a crux and keep that part short. Lose concentration here and a bomb-out is almost guaranteed.

The bottom line of the flow of the day theory is to plan your flight to go with the flow, and that pushing upwind into a strong valley breeze on cool mountains will put you on the ground almost as quickly as a spiral dive.

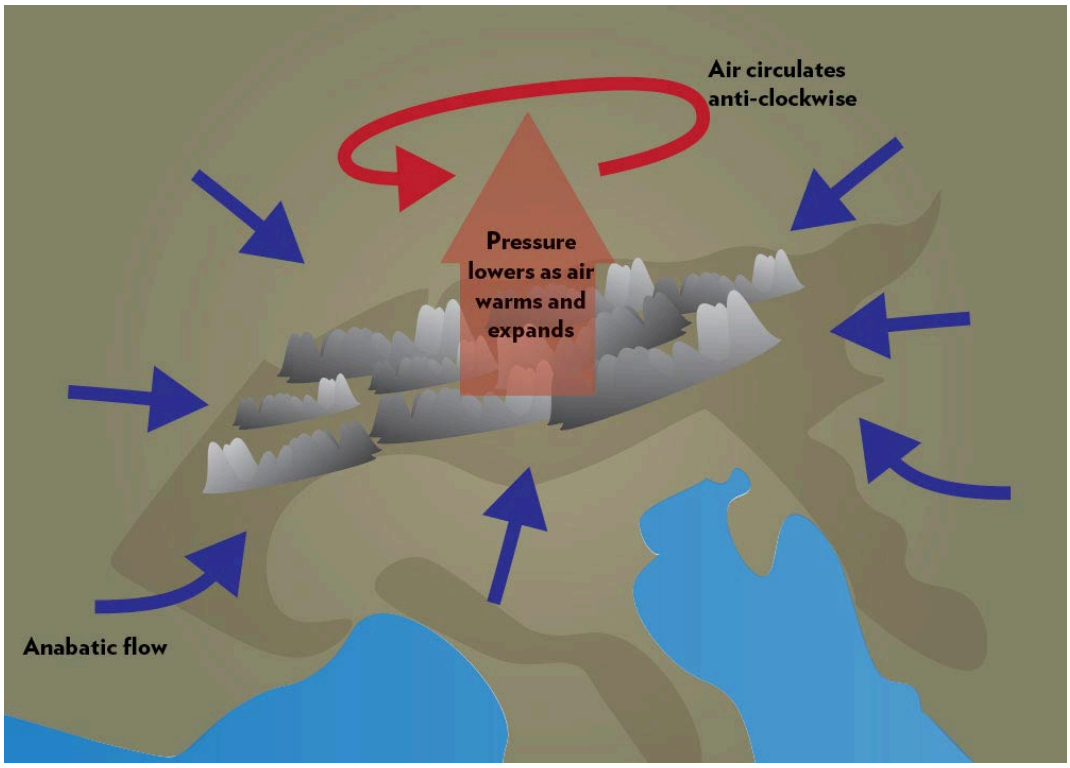
Valley flow

LET'S LOOK more closely at valley flow. When we plan XC routes around the Alps we need to understand this important aspect of Alpine valley life. It's a phenomenon that we'll most likely find in the bottom of any valley on a good flying day.

All XC flights can potentially be won or lost by our basic knowledge of valley flow.Understanding the valley wind's depth and strength, and the time of day at which it becomes critical, are key to safe route planning in the Alps. The ability to predict and avoid areas of rotor, or even sinky lines, is important when trying even short-haul Alpine flights.

Most good XC pilots use valley flow to help them reach their goal at the end of a flight. As a rule, staying out of and away from the valley wind is always advisable, but not always possible. Pushing against it… well, if any section of your flight involves this, something has gone wrong before you launched. You need to go back to your planning. Valley winds are never a surprise, which is why we can lean on them as a cornerstone of planning.

Valley winds are not normally forecast, but occur on most good, long, thermic days in the Alps, or any mountain range. Usually, they differ only in strength according to the atmospheric conditions, and, unless you're in a complicated part of the Alps, this flow will always be the same direction. It should therefore be a predictable element in your planning. Don't confuse valley wind with the cold, katabatic outflow, or with föhn, both of which go in the opposite direction to the valley flow.



THE HEAT LOW

The Alps heat up the air more than the surrounding plains. The warm air expands and the air pressure drops. In the plains, air pressure is higher and the air cooler. Air flows into the mountains.

The heat low explained

In the Alps the sun warms the faces and a local anabatic (upslope, sun-generated) flow begins. This in turn drags air from the surrounding area.

This trickle starts a very low-level thermal flow, or magnet effect wind. This can eventually build into a powerful system by itself. But for a true valley flow to form, this is only half the story.

Heating over the whole Alps causes the entire air mass to warm and expand. It's this expansion on a huge scale that causes the pressure to drop. Meteorologically, this is what is called a heat low – an area of low air pressure caused by warm air rising. The theoretical centre of this heat low lies somewhere near the Furka Pass in Switzerland. The same effect happens over the Iberian peninsula.

Although it is not to be confused with a low pressure system, the heat low does cause the air to move anti-clockwise towards its centre. It draws air in and up, rotating. The pressure over the surrounding plains remains higher, and so air flows from the plains towards the mountains.

Imagine this pressure difference acting like your lungs do: slowly breathing in as the pressure drops over the day, and slowly out at night as the cold air descends.

Predicting valley winds

Ninety-nine percent of the time valley winds will flow in the opposite direction to the rivers in the valleys. This is because they are a warm, buoyant anabatic flow – basically flowing uphill. Only when there's a vacuum effect from a larger nearby flow will the opposite happen. These are local quirks and can't always be planned for; this is where local knowledge rules, I'm afraid.

This low-level flow moves towards the centre of the Alps. Because it is at low level it means the air can only enter the Alps where there are gaps large enough to allow the low pressure to fill. Expect strong flows in large, wide valleys that feed this insatiable low pressure. Kufstein and Lake Garda are at the heads of two such valley systems, to the north and south sides of the eastern Alps.

If a pilot plans to fly in the north-east quadrant of the Alps, they can usually expect the general flow to be from the north-east. But, as it's a low-level flow, it will be shepherded by the terrain. Long north-south valleys can expect a northerly flow; east-west valleys can expect an easterly flow. However, trumping this is the 'river effect': pilots must look at what the river run-out is doing before expecting an easterly in the long east-west valley of the Pustertal – it's most definitely a westerly there. This is because the Dolomites massif rises up against the mountains around it.

Although the valley flow can't go through mountains, it does like to rise, and any warm air trapped in the flow will trigger if suitable conditions allow – pressure, lapse rate and topography.

Valley winds will be at their strongest around June/July, as thermals are strong and snow has receded. Although April may have

some of the strongest thermals, there's not enough bare rock to produce the overall warming of the entire region; the pressure difference is not great enough to draw in large quantities of air (although you'll sometimes find a strong, low-level thermal breeze in the bottom of the valley).

Valley flows can continue after sunset, and long after the last thermal has torn away from the terrain. In the past I've estimated that this flow, although non-existent at ground level because of the cold outflow wedging underneath it, goes on well into the night. It's hard to test, but I've witnessed and experienced flights at dusk where pilots are still standing in 25-30km/h valley winds way above the ground.

If pilots know the depth, strength and the time of day the valley flow becomes critical, it allows them to safely negotiate the chessboard of the Alps. Blundering from one lee side to another will quickly see a pilot land, feeling a little worse for wear. Avoiding its negative influences is the key to a successful XC mission. If this sounds daunting, don't worry: one thing on our side is its predictability. The rest is logic and tactics.

Dealing with cruxes and constrictions

BEFORE introducing one of the most important theories in this book, the Bridge Principle, I want to explore two key parts of cross-country flying: cruxes and leesides.

Study a map and look for cruxes – the hardest part of your route. Look for places where you might get stuck or end up low, then work backwards. (You can also look at tracklogs: where people regularly bomb out on a classic route is probably a crux.) These are crucial, key steps on your route. They may include long glides or areas of potential heavy sink, for example around steep mountain passes.

Next, work out whether your day will allow such a long crossing. How high is base? How high do you need to be? Knowing that is important before you embark on any transition.

Elsewhere, work out where you'll be able to push on, maybe along a hot, unbroken ridge late in the day, dolphin flying until it ends, or until you really need to start climbing again. Understand where to invest time and where you can push.

When we cross valleys it's important where we cross to. Blundering from sunny face to sunny face in the northern Alps will eventually see a pilot landing both shaken and stirred after rotor spits him out.

Treat every glide as an obstacle. How much height or invested time do you need to cross that small valley? The next col? Or even just to safely join that gaggle close by? In the beginning, take more height than you need. The trick to increasing average speed, and therefore covering more ground on any given day, is not having a heavy foot but only taking what you need to push on. Risk nothing in the beginning. Set challenging but achievable routes and get a good hit rate. Only then try to push on and/or extend the route.

Sometimes it's better to follow someone more experienced. Guided courses are a great way to understand why decisions have been made; this fills your filing cabinet of experience faster than if you always fly alone. Trial and error is a time-consuming method.

Constrictions in terrain

Flying near constrictions in terrain can make or break a flight, as everything downwind will have an exaggerated effect, both positive and negative.

When studying the topography of an area that you intend to fly, it's important to look for any narrowing in the valley's layout. Obviously, if you were standing on the valley floor you could expect the wind to get stronger there. I'd also expect the valley wind to rise in altitude as the air struggles to fit through this constriction.

Upwind from this feature it's business as usual – but downwind is more interesting to us. Any soarable faces that force the valley flow up them will work earlier than other faces in the open part of the valley.

Sometimes that's good news. Those faces will also experience a stronger wind, so shallower slopes might work that would normally not. However, launches in that area could blow out sooner or increase the compression to above our trim speed at the height of the day.

On the flipside, any leesides downwind will be active earlier, and when the valley wind is at its peak these can become incredibly dangerous. Blundering blindly often enough into these areas is a recipe for eventual disaster.

Landing late afternoon in a constriction will almost certainly see little, if any, forward penetration on a good XC day in late spring.

This compression of the valley wind will affect the soarable faces and the topography's leeside activity, and will produce areas of intense sink until the valley flow is allowed to spread out.

Downwind of a constriction we can expect everything to happen earlier and have more intensity. This has both up and down sides, but areas close to its influence should be treated with respect. Interestingly, some mountains only work or are feared because of the topography upwind of them. It's a fascinating subject.

Technique vs Tradition

There are some routes which go a certain way because of tradition and do not necessarily follow the flow of the day theory. These

routes are usually tough to complete and rely heavily on the pilot never coming into the valley flow. It's easier said than done.

But if doing a route the 'valid' way puts a pilot in a potentially dangerous situation because of the valley flow later in the day (steep passes and dubious leeside activity are the obvious hazards), then another way has to be attempted. Avoiding the most hazardous areas when the valley flows are strong is desirable, as it is the lesser of the two evils. In my experience, these traditional routes would see a greater number of successful attempts if either the start or finish point was altered, *and* the flow of the day theory was respected.

Landability

No route should be flown over areas with limited landing options. Nothing kills the brain's ability to think quicker than paranoia about landing in a tree, gorge, vineyard, lake or other hazard. Tiptoeing through these areas is the only way. Imagine the whole area is submerged, with only small islands poking out of an angry sea. Make sure you can always glide to the next suitable landing zone before you head into the unknown. Glide often enough over a flat forest or body of water and eventually you'll lose the gamble.

No move that you make on the chessboard should have the penalty of an 'unorthodox' landing, whether that includes a swim or a rescue from a tree. As usual, a pilot's method of flight should have longevity. Looking down for potential impromptu landing areas will definitely distract you from the task in hand, which is studying the sky and staying up.

Flying over or near civilisation will enable a pilot to concentrate on the climbs and not have to panic about going down and giving himself a long walk out. This may not be as important as maintaining landing options, but it will help in keeping the mind free to adapt and relax enough to keep the basic carve and map in hand.

Of course, this really depends on how motivated a pilot is for his or her goal. Only you know that. In the past I've walked out for hours in competitions, feeling the risk was worth it. However, I've

still yet to fly over totally unlandable terrain, and I'd never recommend it.

The dynamics of lee

WE'VE LOOKED at valley winds, cruxes and constrictions, and we've learnt about the flow of the day principle. Hopefully you are getting a feel for where we are going, but before we stitch it together let's look at lee.

Air behaves exactly like water. If you've ever looked into a fast-flowing river, you'll have noticed the way rocks and obstacles disturb its flow. This is an accurate depiction of what happens to air on the lee side of either the meteo or valley wind.

Air has mass. At sea level, a cubic metre of air weighs about 1.2kg. Consider a strong spring thermal that triggers about 1,500m below cloudbase with a diameter of 300-400m. Such a thermal will have a mass of about a quarter of a million tonnes. Not kilogrammes – that's tonnes. And this air can be moving at 6-7m/s.

This is a huge amount of momentum. I hope you can now start to picture the raw power of nature. We need to respect that power, because we're riding insignificant plastic bags around these colossal columns of air.

Understanding now that air has mass, imagine when a 30km/h valley wind, 1,000m deep, is forced to change direction, tumbling over a hot, sunny flank low on the valley side.

As the heat from the sun warms the slope, the warmed air grows in volume, lowering its density. It starts its journey skyward. This rise draws laminar air from the surrounding valley floor. This is pure magnet effect (see p205). But something different is happening here. This strongly heated slope happens to dwell in an area of serious rotor.

Laminar air dragged from below is twisted and churned; sometimes this is even enough to cause it to trigger. If only we could see it: air that stays in contact with the rotor zone, receiving more heating as it rises, would be unrecognisable compared to the laminar, clean flow dragged into this local system below.

Its inertia takes over from here – the same inertia as a normal spring climb has, but with one major difference. When this climb is

eventually freed from the terrain it will have no chance of being anything other than a twisting, hard-edged, nasty column of rising rotor.

The inertia effect here can sometimes last for a thousand metres before the thermal gradually starts to take the shape of a laminar climb again, if it ever does. It depends largely on the wind strength and, equally important, the steepness of the tumble zone. Steep, sharp terrain will produce nastier rotor than something shallower, or more rounded for a given wind strength.

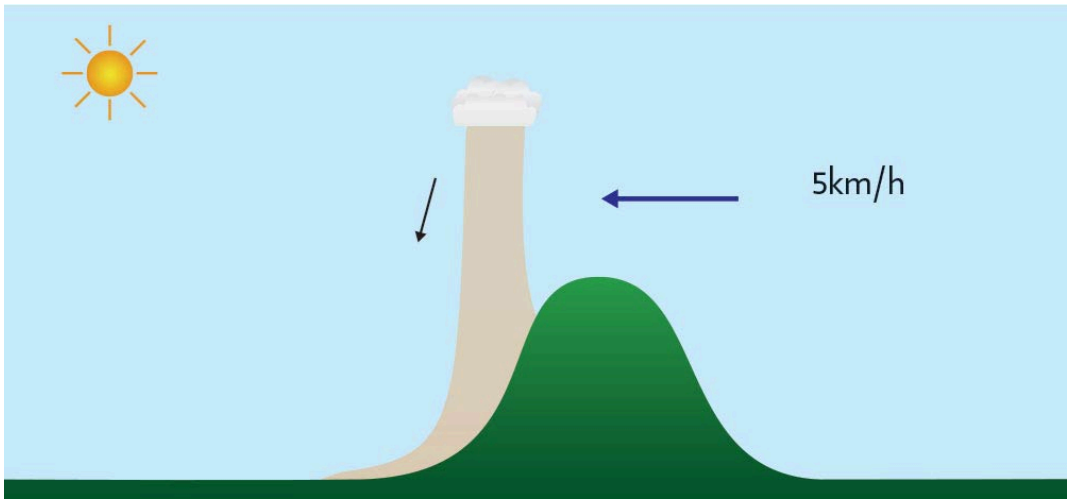
Climbs that form in areas of extreme rotor should be avoided at all costs. When you plan a route on a map, you should identify and navigate away from these nasty places if your XC is to be successful and stress-free. This is a fundamental reason why we use the Bridge Principle, as outlined in the next chapter. (As a preview, it roughly says that when you're low in the influence of valley flows it's better to take climbs on windward faces and avoid these rotor leesides.)

Such air can be very obviously dangerous to us, but where is the threshold at which leeside activity starts to become uncomfortable and even dangerous for us? The trigger wind speed when the lee becomes a hazard, and not just a stronger potential climb, is around the 15km/h mark. Anything less than this is acceptable. It's also the amount needed for any given face to become soarable.

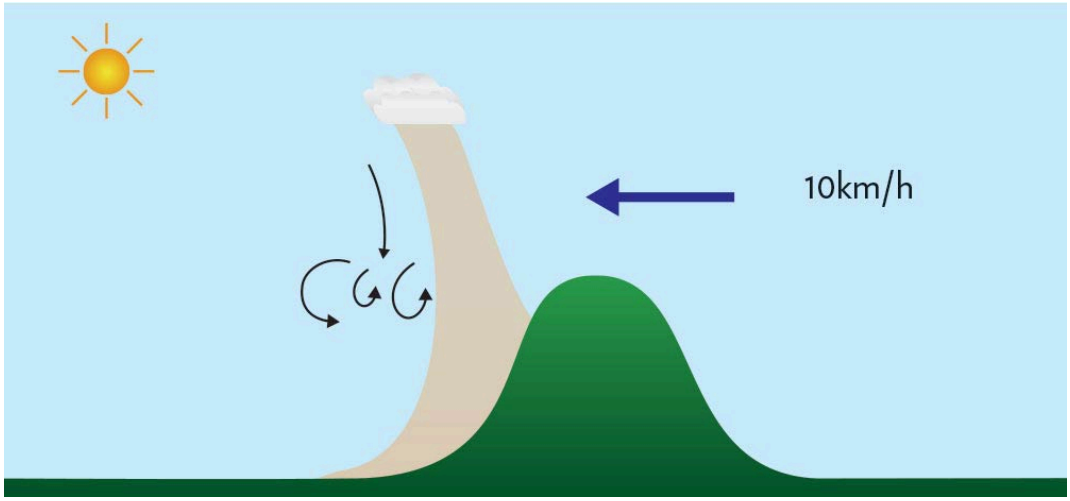
Wind speed vs leeside

As the wind speed increases, the amount of turbulence increases exponentially. Paragliders are not designed to fly heavy leeside. No matter how macho or cool it may sound, hanging out in leesides often enough will push the passive safety bubble of our equipment to the limit. Eventually something will give. You won't have a long career flying leeside after leeside.

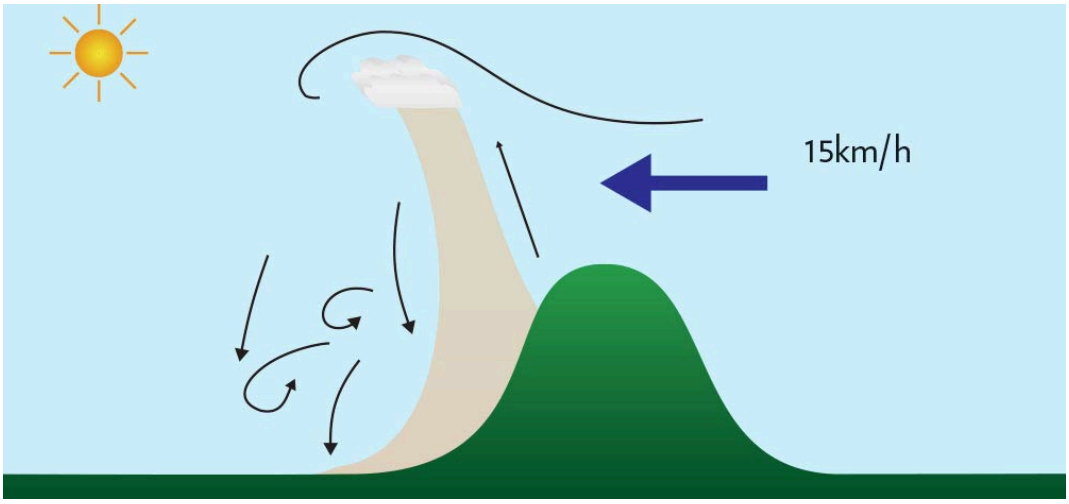
Here then is a rule-of-thumb guide to what to expect when flying leeside in the mountains with different wind speeds:



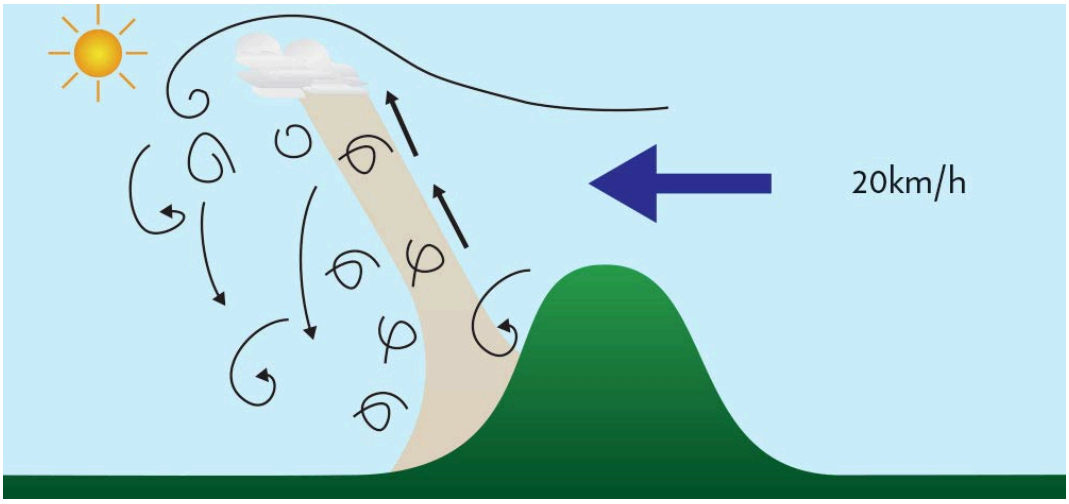
At **5km/h**: it's hardly felt, no problem. A pilot may experience light drift, but no real hard edges or problematic turbulence. Comfortable to fly.



At **10km/h**: we're starting to feel it. The source is starting to get disturbed, the core is definitely felt further upwind.



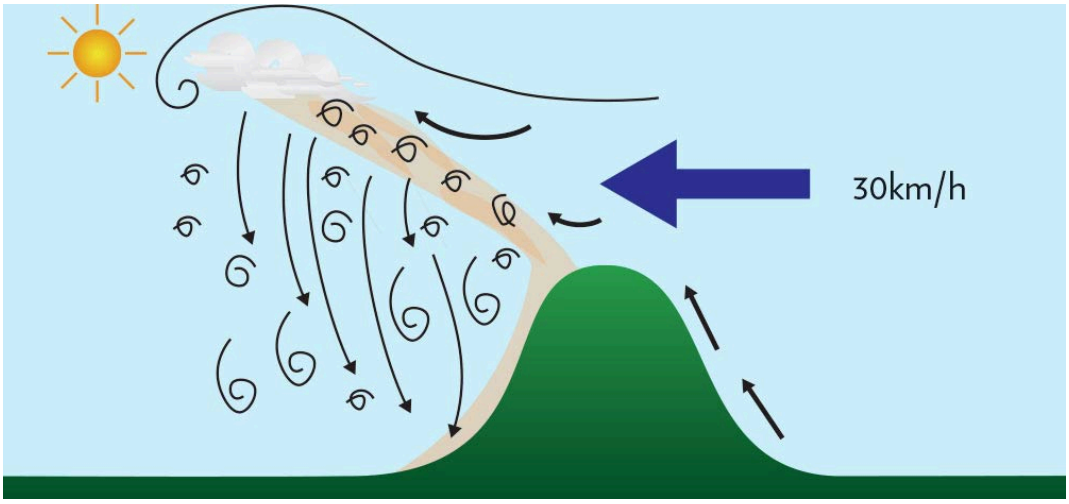
At **15km/h**: this is the limit for fun flying. The weaker parts of the climb will have been pushed downwind and some heavier sink will be found on the outskirts of the climb. The core itself could be strong and twisted, this climb will start to snatch our wings forward. Care should be taken not to lose the nose in conditions like this.



At **20km/h**: it's getting very sporty, with hard edges – only for very experienced pilots. There's a lot of drift and associated heavy sink around the broken climbs – potentially very nasty given the wrong factors.

Options are limited for even strong pilots. Dice rolling, and extremely precise handling, are required.

At **25km/h**: strong, hard-edged climbs, but nasty turbulence. All bets are off at this point.



At **30km/h**: it's not really flyable, with extreme turbulence. Accidents await. Add this wind to very strong spring heating of the area, and hanging out here will eventually see a pilot lose control of the wing. Definitely a good way to find out what it's like to throw your reserve.

Our trump card: the bridge principle

WITH OUR new understanding of the flow of the day principle, the leeside, valley winds and cruxes, we can now introduce what I believe is the most important aspect of Alpine flying, helping you stay safe and out of trouble, especially when down low. The concepts here will help you carefully choose safe places to cross valleys, navigate the valley wind and predict and avoid rotor.

This is not quite so vital in the southern Alps, as the valley flow tends to be from the south, so the sunny faces are soarable. (This is why launches blow out on the south side much earlier than their northern Alps counterparts.) However, on the northern side this theory is extremely useful when the heat low is drawing in a 25-30km/h flow. As discussed, thermals that form in the rotor of this flow are potentially very hazardous to our health. This is the main reason why so many XC war stories end: "It was going well until the crossing, then all hell broke loose." This might sound familiar to some who have attempted Alpine routes in the past.

Understanding the previous rules on heating and valley flow effects (the heating effect) are fundamental to the route planning and adaptation process. Without following these simple principles we're bound to fail.

However, one set of rules and ideas trumps the heating effect. It helps us plan and adapt safer routes. In fact it may go totally against what the heating effect would instinctively tell you is the right move to make. It's called the Bridge Principle.

Local knowledge is usually king, but with the following theory in hand, although it may not be the fastest, our chosen route will always be safe and controlled. Competition pilots may scoff at this advice, so from the outset I'll state that these rules and concepts may not win you the Paragliding World Cup or World Championship. They will, however, allow recreational pilots a stress-free flight, every time. Saying that, I watched Chrigel Maurer use the concept of 'lee und luv' (leeward and windward) as he blasted through the Ziller and Inn valleys in the 2013 X-Alps, while others struggled to escape.

So the following worked for him, and if it's good enough for him, it's good for us.

If the wind is expected to be over 15km/h in the valley floor, Bridge Principle rules kick in, as this is enough to create some impressive rotor. If the wind's less than that then every sunny face is just a magnet dragging clean air up to its trigger point.

Understanding the influence of valley flow

At some point we all get low. Whether it's by accident or by design, after a planned long transition for example, we can easily find ourselves under the influence of this fast-flowing wind that dwells in the bottom of the valley.

We're still bound to set a route that goes with rather than against the valley winds, that will never change. But the place where we might look for a safe ride out can change immensely from what the heating effect might tell you.

We examined why and how valley winds happen a couple of chapters back. If you haven't read that chapter yet, skip back and read it now before reading any further. It's important to have an understanding of how a pilot can determine valley wind direction, depth and the time of day it becomes critical, at 15-20km/h, as we will put that knowledge to good use with the Bridge Principle.

We know that the valley wind will almost certainly act the same way on any good cross-country day. This is crucial for our planning, as solid plans require predictability. Locally, we know that the direction of the valley wind can be determined by simply reversing the direction that rivers flow in the valley, as buoyant air travels uphill.

Meanwhile, the big picture flow will depend on which quadrant of the Alps your route will take you through. The air around the Alps will run towards the theoretical centre of low pressure. This is commonly known as the heat low, and forms throughout the day. For example, in the north-east quadrant of the Alps the main flow will run from the north-east. Since it's a low-level wind, the topography guides this flow of warm, buoyant air towards its goal.

So N/S valleys will experience a north wind, E/W valleys will experience an easterly down low.

This flow can be anything between 500m and 1,000m deep, depending on time of year and topography. In some areas, in late spring the speed of it regularly exceeds the trim speed of modern gliders.

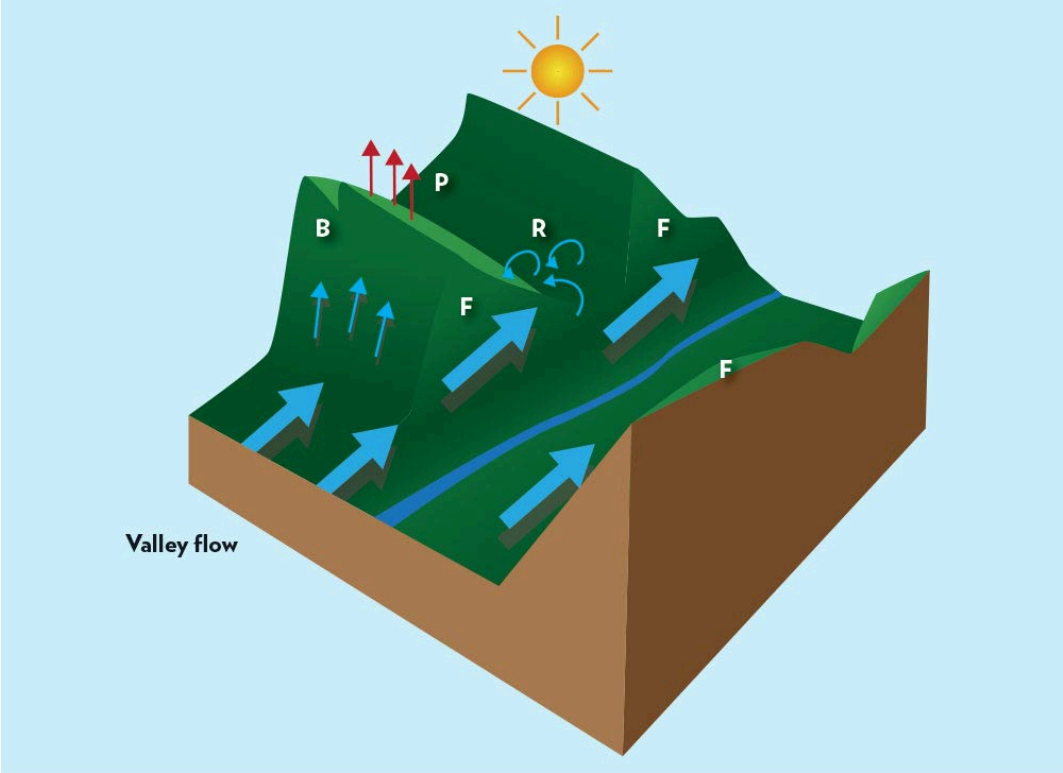
Understanding the direction, the depth and when this flow will potentially cause nasty areas of rotor is arguably the most important aspect of Alpine flying. Even gliding high over a crashing, turbulent leeside will see your glide ratio degrade to that of a cinder block. Finding yourself in its clutches low down can be a terrifying experience.

Low down leeside flying in winds over 15-20km/h is a sure way to test the passive safety of our equipment.

This low-level wind is responsible for much of the uncomfortable turbulence associated with Alpine flying – that and inversions. Add intense heating to that wind strength and it will produce impressive leeside activity that's only for the brave or uneducated pilot.

The valley flow will also have a predictable height that will be similar on any given XC day. Knowing this will enable pilots to understand and estimate where they will come into its influence. The higher up, the less effect it will have.

Arrive on a long crossing in orbit, and the hot faces will show the way. However, most times life is not that kind and we'll need to cover ourselves when coming close to this deep, fast-flowing, buoyant valley flow.



THE FOUR FACES

Here we have examples of all four faces: B is a bridge: the valley wind hits the hill and is forced up the face. This is a good place to soar. The faces F are flushed by the valley wind. R is an area of leeside rotor to steer clear of, but P is protected, away from the area of rotor, and sun-warmed so could offer a leeside thermal.

The Four Faces

Any face in any mountain range can be said to fit into one of four categories. In fact, any rock, any tree or any square metre on a hill can be pigeonholed roughly this way. And roughly is all we need to make an informed choice about what will make a safe route around the arena we plan to fly.

Of course, I'm writing about what is happening within the valley flow, but the plan should anyway take into account the forecast meteo wind – and it should be light enough to allow safe passage through.

Understanding these four categories implicitly will enable pilots caught out by unplanned events or conditions to make a quick and

informed choice as to where to go next. On the move, the Bridge Principle truly is our emergency technique.

Whenever there's a large change in the direction of the valley's architecture, there's the potential for both leeside activity and an easy ride out. This is also true when two valley systems meet. This yin and yang of Alpine flying is the basic concept of the Bridge Principle.

1. The Bridge

We call a mountain, or part of one, which has air forced up it a Bridge. Even surprisingly shallow angles to the flow can work. There a pilot can rely on a laminar flow and buoyant air being allowed to run up the terrain.

Depending on the stability of the air mass, it's where we might find the flow's embedded thermals triggering. Bridges that jut out into the flow are obvious places to wait until such a thermal is released; they allow the thinking pilot to continue on their way once they are out of the valley flow. They're our bridges across these fast-flowing rivers.

Planning your bridge is important for continuing safely and in comfort. The ability en route to spot other potential bridges will keep you in the game should things not go 100% according to plan.

2. The Protected Lee

Another spot is hidden deeper in a side valley; a laminar flow rises here, pulling in air from the heat reservoir below. The climb is strong but clean. How hard-edged it is depends again on the stability of the air mass that it's forming in. This flow is clean because it avoids the tumble where the terrain changes direction. These areas are known as protected leesides. For stress-free flying, incorporate as many of these as you can into your plan.

3. The Flush Face

The next spot, or face, is almost indifferent to our cause; it's called the flush. It's good for drifting along, but never really allows the flow to rise up its flanks. It simply directs it; thermals attracted to these

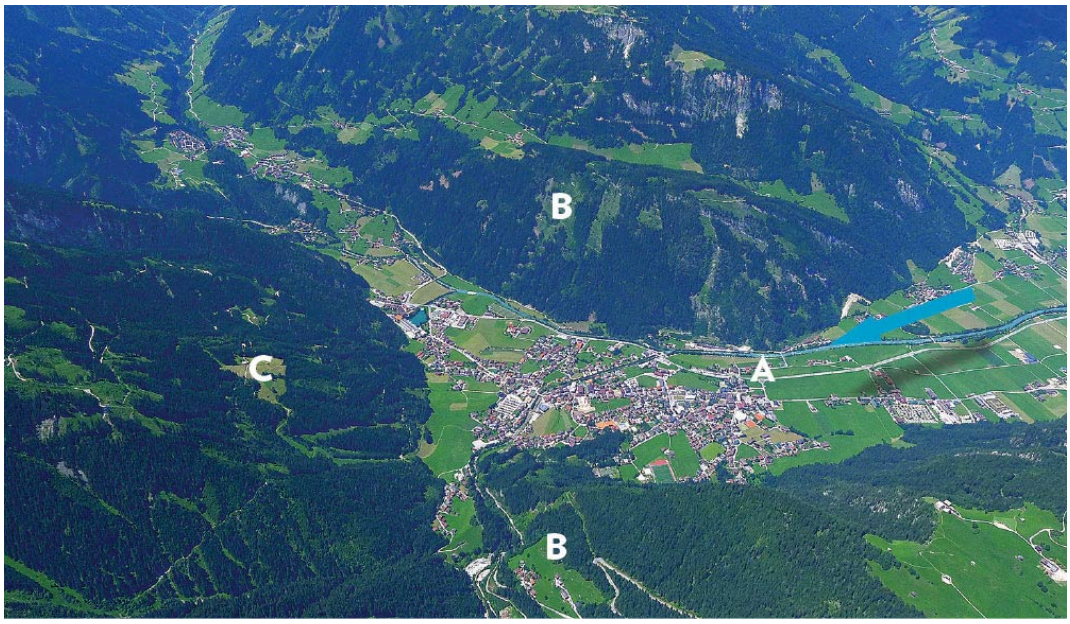
sides will just drift with the flow. They're neither clean soarable areas nor particularly rough. They're just there to make things more complicated until we can find a bridge to maintain on. Think of them as inert magnets that can draw large quantities of hot air up from the valley floor. Recognising where this drifting, meandering flow may be triggered will help immensely when stuck on a face like this.

4. The Rotor Lee

Last and by no means least is the worst case scenario. Certain areas should be avoided like the plague in winds over 15-20km/h. These areas are where the flow has been forced over or around something, and is now tumbling and crashing. These rotor lees are responsible for most incidents in the Alps. They need to be recognised and avoided. Such faces can produce twisted climbs that stay twisted through the air's heavy inertia to cloudbase and beyond.

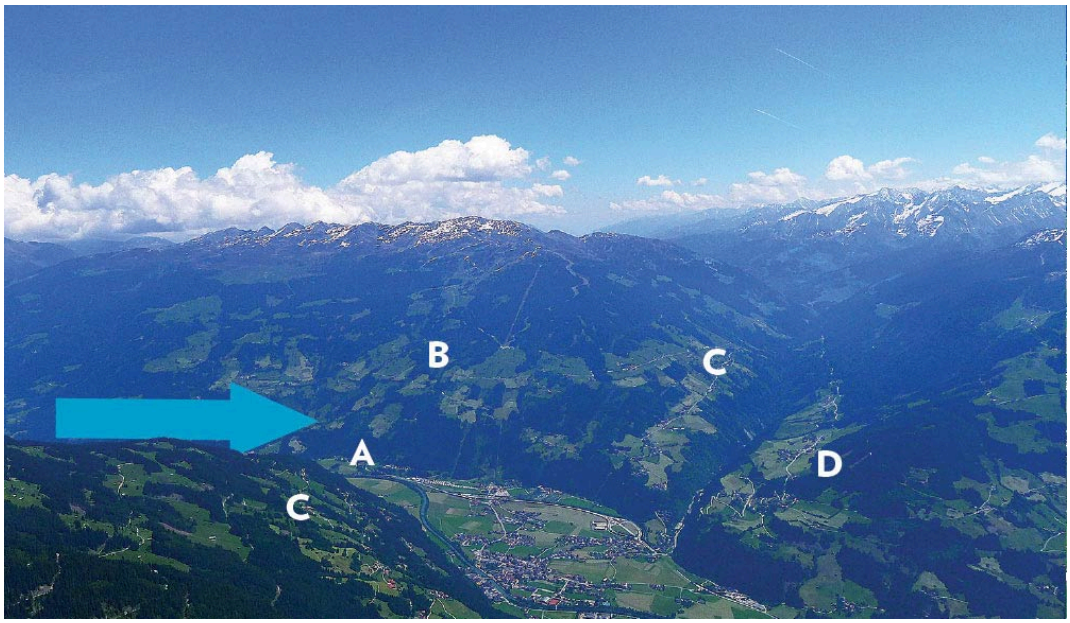
There's no downside with the Bridge Principle. If a pilot enters the influence of the valley flow and finds that the wind is less than the rule's trigger speed of 15km/h, there's always the option to go light leeside as the next move. But, if the same pilot decides to take the climb on the sunny side of a 25km/h rotor, his options become slim. Pushing forward to the windward face will be painful. Running downwind to the next bridge is the only way out of this predicament. Staying and fighting in this area will be both hazardous and stressful.

Another upside of this theory enables us to bounce out of side valleys. Remember that wherever two valleys meet there'll be a potential easy ride out on the wind and a nasty area of rotor, should the wind be over 15km/h. Stay in the protected area until you reach the boundary of the rotor area, then run with the wind to the obvious bridge on the downwind side of the junction. Remember, your chosen bridge should always be downwind of the valley flow.



VALLEY CONSTRICTION, SOARABLE FACE AND ROTOR LEE

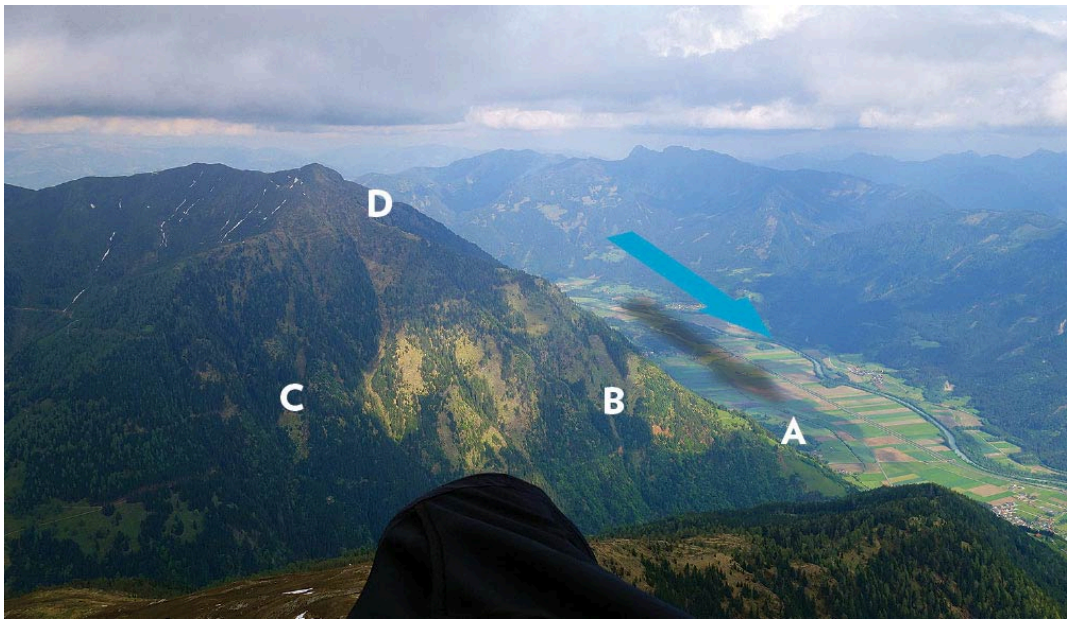
This is an aerial shot of the south end of the Zillertal valley from around 3,800m. The arrow shows the direction of the valley wind. Note the compression at A and downwind the two 'rotor-leesides' at B. Hanging out here when the valley wind is strong can be bad for your health. However further downwind is the house mountain, C, the Ahorn, a soarable face and classic 'bridge'.



FLUSH AND SOARABLE

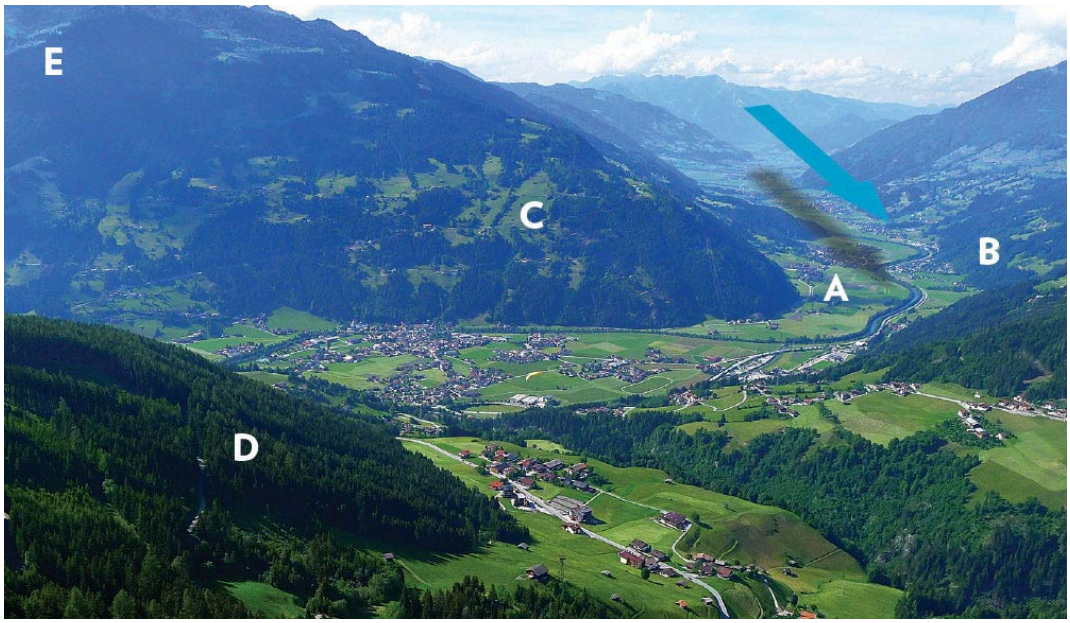
This shot shows a severe constriction at A. Downwind are the exaggerated effects of these rotor lees, C, and the soarable 'bridge' at D. The long westerly facing ridge, B, is an

excellent example of 'flush'. If low here pilots can just drift along in weak climbs, hopefully in a favourable direction.



ROTOR LEE AND PROTECTED LEE

The valley flow moves towards the higher ground, to the right. There is a rotor leeside at B and further inside this side valley a protected leeside at C. If the wind is strong it can be safer to go further in to climb, but ensure there are safe landing options. When the valley wind is strong, the climb at B will be nasty: sailing over D would be the best option if cloudbase allows. If low, the wide line out to A and then on to the ridge, avoiding the sink and rotor at B, could be a good option although it's a longer line.



SOARABLE, FLUSH AND LEE

This picture shows the same area as opposite but from a different angle. Point A clearly shows the constriction, B the flush face, C again shows the rotor leeside area and D is obviously soarable with the wind coming out of the photo. E depicts an area that is starting to become a 'protected lee' area.

The 3D Chess Game

First get a decent map of the area that you'll be flying – Google Maps is a great source when zoomed in. Now, all plans rely on being able to take some things as read. We're assuming that the weather forecast gives light winds aloft and a flyable day long enough to complete your route, meaning that the chance of early overdevelopment is low. How far you fly depends on your average speed.

Over many years of guiding and coaching, I've noted that recreational pilots seem to have about three or four hours in them before they succumb to fatigue or bladder control problems (the latter often solved by today's widespread use of condom catheters). With an average speed of 15-25km/h it will be theoretically possible to complete a 60-100km route. But in the beginning try planning a simple 50-60km if you're not used to flying in strong conditions. Be realistic about both your ability and your goals. Only when you can plan and execute routes is it time to extend them and go faster. Planning and flying conservatively in the beginning is the best way to progress.

Back to the map. Now, we should be able to recognise on it all the nasty places that we should avoid when the wind hits the trigger speed of 15km/h. Less than that and we can go where we wish, as long as we follow the heating effect of the flow of the day, joining together hot, long unbroken ridges. Armed with an average ground speed of 15-20km/h, we'll know our location roughly at any hour of the day. Cruxes are planned for and strategy is in hand. Long transitions could expose us to risk low down while we chase the sun's energy. Care should be taken to choose a nearby bridge, downwind of course.

Use the previous strategies to plan your 3D chess moves. Avoid rotor lee pitfalls while joining protected areas together, using bridges to cross the fast-flowing river below. Never break the flow of the day. Fly efficient lines along unbroken ridges, taking only what you need, because the sun's procession is unrelenting and will not show mercy if you happen to get stuck or stop to take in the views.

This is what the unsung heroes of the anti-glamour XC scene are doing. They're alone for 10-12 hours a day with no goal-field glory. The likes of Stephan Stiegler, AirDesign constructor/designer and former Paragliding World Champion, and Thomas Walder, world record holder, understand these rules. It's no surprise that they're pushing the FAI triangle limits to the absolute edge.

Cover yourself

The more you understand, the more the terrain closes down to an experienced pilot. What's left open is 100% safe and can be exploited with trust rather than tentative faith.

These planning and adaptation techniques are something that I've dubbed 'covering yourself'. From route planning to staying out of clouds when climbing (the helpful 45-degree rule), all these techniques help emphasise the saying: "A superior pilot will use superior judgement to avoid using his superior skills."

Work on the premise that the earlier you recognise, the less you have to react.

Flying plastic bags around the Alps at the strongest time of the day shouldn't be left to the result of a coin toss. So cover yourself. Simple.

Where to go

What makes an Alpine site good for aspiring XC pilots wishing to safely push their abilities? Choose an area with a wide, flat valley floor. No one wants to be squeaking over flat forests to reach a suitable landing. And the valley sides should be steep enough to allow an easy escape to the flat open floor below.

After these safety considerations, it's just a question of whether the site and area tick the boxes to follow the day's flow. The weather holds the cards, and you can only go with the day you are given.

50km classics

When you're starting out, the 50km classics around the Zillertal and Lake Annecy are technical enough. The former allows pilots to understand many classic Alpine scenarios in a relatively short distance. The latter lets pilots cruise around the lake just using the valley flow and the thermals that it carries, triggering at sometimes unlikely points.

100-150km routes

The south-facing sites of Greifenburg, Fiesch and not forgetting the Pinzgau Valley are often used for simple but long out-and-returns. They're also included as long, fast legs of triangles. Once the basic steps are mastered, these are great arenas to eat kilometres on a 100-150km out-and-return. XC flying is limited only by your imagination, your skill and the length of the day. So be creative, realistic and obey the rules. Stay safe.

Adapting your route

Being able to plan a route is very important, but what if situations change? What if your route choice shows signs of overdevelopment and a whole new route is required? Or, more subtly, what if you fly faster or slower than you planned, so that you arrive at crucial points too late or too early? That's when route adaptation is king, and that's coming next.

Route adaptation

ROUTE ADAPTATION is simply the ability to go with the flow en route when something forces a change of plan, picking a new route while you're under fire in strong conditions and making good decisions based on the previously explained topics. You want to go from strong line to strong line, not just blunder around the landscape.

This sits above route planning in the pyramid of progression, as it enables pilots with a solid plan to adapt it to a change in circumstances. It comes into play when a pilot is too fast or too slow and has to cross a valley at a different point to the plan, or it enables the same pilot to push further along an out-and-return before turning around.

One of the main calls for route adaptation is when pilots with limited Alpine experience get stuck somewhere. This can dramatically change a pilot's average speed. It means that a sunny aspect may no longer be producing reliable enough climbs when you reach it to make your planned crossing of the valley flow. You may already be low, and it could mean you have all your eggs in one basket. Remember, when you're crossing low enough to be in the influence of the valley wind, you must take care – Bridge Principle rules here.

Imagine this situation: you're low on a shady slope and need a bridge to cross to a warmer but windward face. Diving into a rotor lee after a long crossing is why those war stories I've mentioned end the same way: "It was all going well until the crossing, then all hell broke loose..." Usually the pilot is flushed to the ground feeling shaken – or, worse, suffers a tree landing after a low-level collapse in turbulence.

I've witnessed this often in the Zillertal. It's caused by either a lack of understanding, an underestimation of wind strength, a simple lack of experience, or a combination of all three.

Another reason routes can need to be adapted is that the chessboard we fly is constantly changing. Perhaps there's a large

area of shade or an overdeveloped cloud over a chosen turnpoint. Whatever the reason, it's important that pilots have a strong grasp of the concepts that helped them chose a solid route to begin with.

It is vital to have the carve and the mapping in muscle memory, leaving the pilot's brain free enough to calculate a new route and understand the risks involved.

This is why, although there's nothing wrong with attempting XC in the earlier stages of your flying career, you can expect limited results. And it's not unlikely that inexperience in the sport will lead to pilots relying on the passive safety of their equipment.

I often say, "It's not what you fly but where you choose to fly it. Dive low into enough windy leesides, and you'll find out what colour your reserve parachute is." In my opinion the sport is extremely safe, but please give it a chance. There's no longevity in relying on the results of a test pilot's findings over a lake in perfectly smooth conditions.

Educate yourself, see the risks and work backwards. I call this aspect covering yourself. The devil never sleeps.

This finishes the XC route planning chapters of the book. The next few chapters take us to levels that are even more conceptual and I, as a pilot since 1996, am still learning. It's so subtle and invisible. Each day is different, but again, if you're high up the pyramid of progression, you'll have gained a large amount of experience. By now you'll have your own ideas and will have built a large database of knowledge, based on both your past successes and your mistakes.

Efficiency tools

WE NOW approach the end of the pyramid of progression that I explained at the start of these pages. To recap, my theory is there's little structure for solid progression in free flying, especially out of school. It's mainly learning-by-doing, which can be frustrating.

So I devised something I called the pyramid of progression; it introduces a logical, structured way to develop skills that are needed for safety in our sometimes confusing sport.

At the bottom sits the foundation: techniques to allow the pilot to leave the hill with not just perceived but real control; to carve efficient 360s; and to effectively map climbs. These are the fundamentals and must be practised until they're embedded in our muscle memory.

Once a pilot has these skills nailed, when they can thermal on autopilot, only then will they have the brain capacity to choose lines and adapt routes around the mountain chessboard.

Near the top of our pyramid are the efficiency tools. Efficiency tools allow us to shave off time from any given route, or extend it. They help us use all the available hours of flyable conditions in any given day and increase our average speed, which means flying further.

These tools are the icing on the cake. In this section we'll look at what makes a good line, then we'll examine in depth how to glide better down that line, and finally we'll see how to increase our average speed and potentially lengthen our flight – or simply get round a route quicker.

What makes a good line?

Paragliders are pretty inefficient machines at the best of times, so when you add a headwind or some sink into the mix you end up with very poor performance. A carefully chosen line can help you avoid that 'sinking like a stone' feeling. Stronger lines enable us to arrive higher over the next hot spot or trigger, therefore allowing us to spend more time gliding and less time climbing. Going round in

circles to recoup altitude lost from a poorly chosen line brings down our average speed.

Even worse is a line that traps us under some layered stability (inversions). If you're stuck, the sun doesn't stop its relentless procession across the sky. Choosing lines is simply adapting previously planned routes to a greater or lesser degree – adaptation in the moment.

On days with cloud development obvious lines are easier to spot, but what makes a good line with clouds also works on drier, blue thermal days. An intermediate glider on a good line will prove better than a high-end wing on a bad line, every single time.

Traditionally solid lines

Before I go any further let me clarify what I mean by choosing lines. I mean the concept of choosing a good, reliable route to take us over terrain and to cross valley systems.

There is another type of line that pilots do talk about, however. And that is the art of following lines of lift and microlift through the air. These are ever-changing and invisible, usually not even marked by cloud.

A good friend of mine, Nick Greece, suggested that the art of choosing this type of line is the top of our pyramid. It is such a black art, almost impossible to conceptualise, and only comes with thousands of hours of varied flying that it sits right up there with Natural Flying, flying like a bird.

However, before we get anywhere near that we must be able to understand the traditional concept of choosing a good line and flying it efficiently and therefore quickly. So it is that that I focus on here.

Over the next eight pages I examine some concepts, both theoretical and practical, which will help you become a better and more efficient pilot.

1. Thou shalt follow the Flow of the Day

The Flow of the Day rule can be split into two parts: the Heating Effect and the Valley Flow Effect. Both should be taken into account when choosing a line. Going against the flow of the day is generally

a bad idea in soaring flight, especially when flying slow plastic bags. The path of least resistance is king.

Long glides along cool faces or fighting a headwind will usually see a pilot slide off the hill. Gliding along warm faces and working with valley flows will see your glide angle increase.

A lot of this comes from previous work done on a pilot's route plan. As I've said, line adjustment is just high-level route adaptation. There are some definite ways to help yourself, though, when flying routes, no matter how long or short, around our amazing playground.

Avoiding glides on the lee side of a strong meteo wind will help increase your glide angle. Generally, flying with a strong meteo wind is tough as lee equates to turbulence and large areas of descending air. If possible always stay windward, especially in the high level with winds over 15km/h.

2. Snowlines and cloud-shadow lines

Early in the season it's very common to have a defined snowline along ridges. Warm buoyant air from the valley floor is attracted towards the sunny faces. These hot faces warm the air further and feed themselves from the floor below. The air sticks to the slopes and forests until it meets something that forces it to leave the terrain. In this case, it's a wedge of cold air rolling downslope in the form of katabatic flow.

It's not uncommon to see clouds form well away from the peaks when there is snow around. Even on blue days you can expect the snowline to trigger huge amounts of warm air. It's a great place to search for climbs and lifty lines alike.

This can be hugely exaggerated if there's cloud shadow on the tops of a snowy ridge too. It can also work without the presence of snow, but the shadowy part has to be cool for a long time to produce the undermining wedge of cold air.

Simply joining dots of potentially reliable trigger points is half the battle, although a lot depends on the viscosity of the air that you're playing in.

3. Lines can depend on the stability of the air mass

You will know yourself that high pressure days tend to have a different attitude to them compared with lower pressure days. And how long the high pressure persists changes the chessboard further. It alters the places where large amounts of air leave the terrain, thus creating possible lifty lines.

Low pressure or 'fizzy' days

Low pressure conditions will usually allow thermals to tear away from terrain at a shallow angle with just subtle changes in topography.

Cloudbase will usually be lower and thermals closer to each other. The climbs may be softer-edged and pulsing more often. This is because the climbs start to roll up the slope under their own steam; the temperature that they need to start rising is lower, and their progress is not halted by inversions.

This pulsing is caused by the uneven heating down below. As air is flowing steadily up the slopes, the 'heat bath' in the valley floor is not truly established. The opposite happens on high pressure days.

Expect good lines to be further out from the ridge in these conditions. You'll nearly always have clouds, and it's easy to spot good lines, especially when you start to know an area, and you can see why ridges work the way they do.

Heaped clouds among streets would indicate a stronger source in that area. However, shade down below quickly kills the day. As cooler air is dragged into the system it turns once lifty lines into sink patches as climbs fall apart.

High pressure or 'sticky' days

On these days, as the word sticky suggests, the air needs to be heated to a higher temperature before it rises. These fingers of hot air stick to the terrain and are heated all the way to the top before they're wrenched from the mountain at its peak – unless they meet something formidable in their path, like a powerful wedge of really cold air. Cooler air late in the season will just be pushed aside.

Hot air won't travel downslope, so it's forced to leave at the very top of the ridge. Air from several different sources may find its way to one tearaway point, making the thermal extremely long-lasting, very strong, hard-edged and potentially turbulent close to it.

This generally means that on higher pressure days pilots should choose lines over the terrain that follow the peaks and ridges themselves. Base is generally much higher on these days too. Persistent high pressures induce warm layers of stability. When the air mass becomes inverted conditions get less predictable, less textbook and more challenging. There will be fewer clouds, slower or stunted climbs and harder, turbulent edges.

XC flying should really take place in air that has a good blend of both attributes, both fizzy and sticky. Pressure and humidity levels should ensure that the day is good and long with no chance of overdevelopment. Give us consistently strong, lasting climbs, with manageable turbulence for even rusty pilots, and friendly clouds forming in obvious places, and we can flow over terrain as if we were born to fly. When all these elements line up the conditions are close to textbook.

4. Inverted? Stay high

Lines to take when an air mass has become inverted are simple to explain but not so simple to achieve; you need some luck too.

The simple answer is to stay over the higher terrain. Avoid gliding to low trigger points; Make short glides from peak to peak; don't allow yourself to sink below the low inversion and into the warm stagnant air of the valley, especially in summer.

Climbing out on inverted days is something of a black art too. It requires second-to-none mapping skills and the precision of a surgeon in the turbulence surrounding the climb, similar to finding yourself in the lee. It can be slow and stressful, but it's rewarding when it works. Once the climb has been halted by the layer of warm air, track back to the higher terrain. The thermals rolling up the side of the mountain will not have lost as much heat, as their triggered-lower counterparts have. This may be your only ticket out.

However, it's my honest opinion that it is inversions that make our sport unpleasant. Super-heated air will always be aggressive compared to air that left the ground on its own terms.

But it's a double-edged sword, as the longest flights are usually made when the air mass is slightly more on the stable side, giving strong, long-lasting climbs and little chance of overdevelopment.

The longer the high pressure remains, the more stagnant and the more turbulent the air becomes. Nature's way of pressing reset is a welcome cold front, although some might disagree.

5. Crossing passes

Great care should be taken when trying to cross steep mountain passes. Blindly gliding across these areas, even at super high altitude, can see pilots gliding at angles similar to those of the early nineties. This is mainly because deep, fast-flowing valley winds can be spilling over the tops of them. As this flow tumbles it expands, creating a relative low pressure and huge lee potential down low; this drags air down from altitude to fill it.

Only cross these areas either early in the day when the valley flows are light, or if you are sure they're areas of known convergence. Otherwise expect to be tractor-beamed out of the sky. A fix in this situation can be to run with the offensive flow to a bridge (an into-wind face) nearby, usually on the other side of the valley. This is the yin and yang of Alpine flying.

Fighting this amount of sink and wind is futile, and takes us back to the valley wind 'flow of the day' effect.

6. Spur hopping

Having to hop spur-to-spur while low can be stressful because we don't have huge amounts of height to burn searching for the next climb. So it's important to have a strategy; relying on luck will only work for a while. With practice you will understand the obvious and sometimes not so obvious areas to place your wing.

The first question is where to aim for. If I'm at a loss as to where is best I'll tend to aim for the spur on a direct line, to a point that

when I arrive I will be 30m-50m over the terrain, although use your discretion.

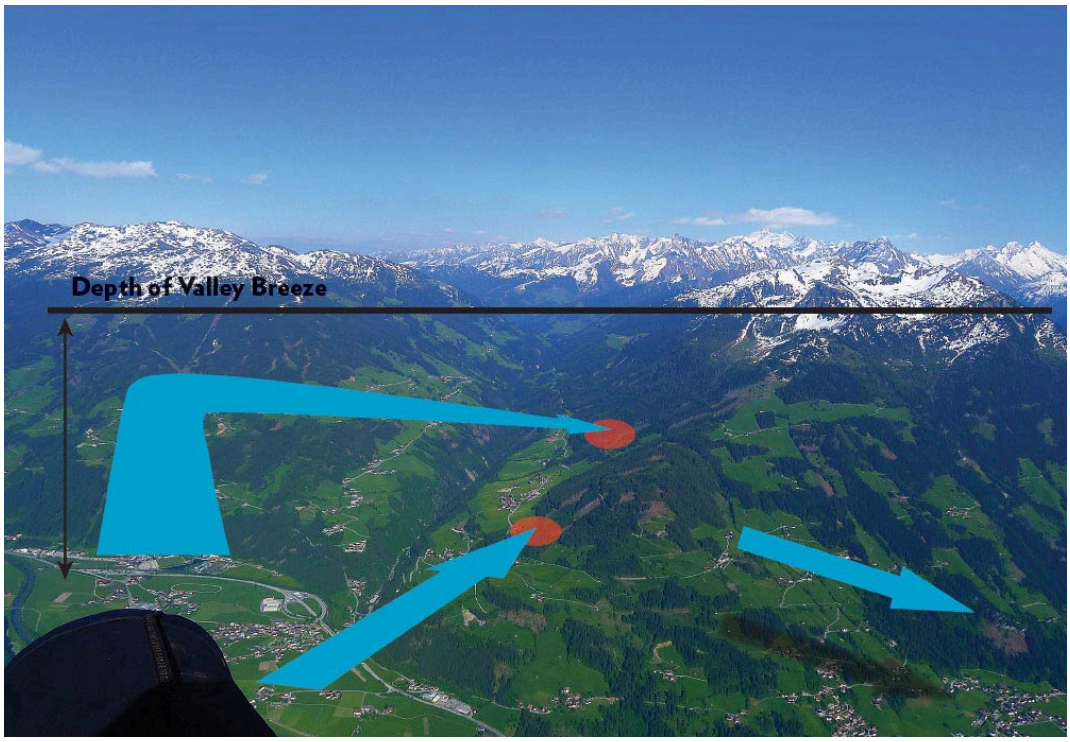
Once there I'll do one of three things. The first is to be lucky and start climbing straight away. If that doesn't happen then we have two other choices, depending on whether the day is fizzy or sticky. This is why it is important to have an understanding of where the day lies on the stability spectrum as the air can interact differently depending on this.

Stable or 'sticky' days: As I said before thermals in more stagnant or high pressure air will tend to 'stick' to the terrain. When hopping from spur to spur on more stable days I might tend to also stick to the terrain. This means that unless there is some obvious reason to glide away from the ridge I will hit the spur and then turn in towards the higher ground. And I'll always try to climb and head back to the higher terrain, 'stepping up' through any inversions.

Unstable or 'fizzy' days: On these days the thermals need less of a pronounced ramp to leave the terrain. In fact sometimes even the climb hitting the slope is enough to trigger the climb. Shadows from the lower-than-normal cloudbase will help trigger thermals.

On these days once I hit the spur I'll tend to turn out and run out along it, hoping to find something from either side, doubling the chances. Often, close in to the mountain in the shade you'll just find cool descending air. On these kind of days it pays to go further outside.

Clouds on fizzy days will show the way. Observe your surroundings and the game will become easier.



CROSSING A VALLEY USING THE VALLEY FLOW

On long valley crossings it is more efficient to glide upwind of your arrival point before falling into the influence of the valley flow, where the downwind component will speed you towards the next source of lift

7. Crossing valley flows

When embarking on a long valley crossing, in orbit under a high base for example, it's possible simply to follow what the heating effect or the flow of the day suggests. Straight lines to a reliable source are all that are required. If you suspect some potential leeside activity after the crossing because of the valley flow though it pays to glide further in, especially if you're arriving in the influence of the valley flow. The protected thermal will usually deliver a smoother ride on the next climb out. Better still, use an into-wind area or bridge, if the flow is strong.

If, however, you are arriving low, ensure you've chosen a good place to aim for on the opposite side of the valley before starting your transition. If you expect a strong valley flow, make sure that you're not blindly gliding low into a turbulent super-heated leeside.

Flow of the day is only half the story when route planning; combining it with the Bridge Principle will keep you out of danger.

A simple tip for arriving higher when you're only a few hundred metres above the valley flow is to glide at an angle up-flow first. Then when you sink into the flow you get a free ride downwind towards your goal. How much of a free ride varies with your altitude and the expected valley flow strength.

Whatever angle you choose to fly, up-flow first is usually better than going downwind or just straight towards your target, as these will result in a cross-wind or into-wind glide. That's never great for an efficient line. Maybe it goes without saying, but it helps greatly if you're gliding to somewhere downwind of your position – the second part of flow of the day.

In the main Alps, above the strong valley flow, there's often little or no wind, as the mountains tend to block any meteo flow, creating a dead or neutral area. Use this to your advantage. This subtle tip can mean the difference between staying in the air or sinking out.

Care should be taken not to fly into the lee effect of any mountains upwind. This can be extremely sinky, especially if there's a constriction. Remember constrictions increase both the height and the speed of the valley flow. Objects downwind will have exaggerated effects, both positive and negative.

8. Pushing over leesides

When pushing to get over a potentially sinky lee, if possible take the most direct line over it. Use a little bar if appropriate. This will maximise your chances of sailing over instead of flushing down and having to take a wide and sinky longer line.

I've witnessed this time and time again, where just 20m-30m can make all the difference. Once we fall into the tractor beam the sink becomes exponential and the line needed to go round the obstacle becomes longer; it's so often a lose-lose.

9. Flying cloud streets using the Corkscrew Line

Let's finish with this one. One safety rule of thumb allows us to use lift in a controlled manner and not be nervous of strong climbs under

cloud streets. It enables us to fly in straighter lines without needing a stressful, time-consuming descent manoeuvre. It's called the Corkscrew Line.

Logic states that if we have 7m/s forward speed and 7m/s upward speed we have a 1:1 positive glide, in other words 45 degrees. Remember this, as this '45-Degree Rule' will come back later (p178).

We can play a little with this angle, but if a pilot keeps the edge of the cloud, or the escape route, at 45 degrees to themselves there's a good chance that they'll escape a visit to the white room – even if the cloud turns on.

This rule does not rely on the cloud being a certain size (area), as the angle remains constant; it works for any size cloud within reason on a safe flyable day. (Although don't try it with cu-nims).

If we understand the concept of the 45-degree rule we can use it to great effect under continuous lines of lift, not just as a safety rule to keep us out of a large cloud. It's similar to dolphin flying under clouds, but with a safety margin built in.

Corkscrewing, or barrel rolling, is the technique of not just circling up the 45-degree line but gliding up the 45-degree line (when close enough to the cloud; lower down this may not work) until threatened with a visit to the white room.

Once there, moving further away from the cloud should find you neutral or sinking air. Once you're happy that you're safe from going in, move back to the 45-degree line again. Repeat until either the cloud street finishes or you need to make a transition. Clouds rarely form in the middle of the valley unless there's convergence.

This technique works fine in both the flats and mountains. It's a slightly different way of looking at good lines as we use the sink of the cloud to enable a one-way flow over the terrain, avoiding stress and leaving our brains free for the next decision.

It is important to note that when choosing which side of the cloud to use the 45-degree line on, it should be either the windward side or the valley side. This will give you both safer and reliably better lines.

10. A final word

Finding good lines is at the top end of the pyramid of progression, and these rules are just concepts. Each day is different, but the concepts remain the same. Remember techniques are not set in stone but the concepts are.

Generally, keeping out of the valley wind's influence will see an increase in average speed. Having a solid plan on the ground, and understanding what made it a solid plan so it can be adapted in the air, is just as important, if not more so, as choosing a good line.

Choosing lines is route adaptation in the moment. Planning for them on the ground helps, but they need to be updated minute by minute. There's unfortunately no one-size-fits-all method for choosing a line, but I hope these concepts will help.

Simply gliding better

HAVE YOU ever noticed how some pilots just seem to glide better, arriving higher after every transition and seeming almost to bounce as they extract energy from the sky?

Contrary to what I'd prefer, glider performance has something to do with this, in the right hands of course. And the more streamlined pod harness is very helpful. However, the main reason for their success is the lines they choose over the terrain.

As I've already said, a solid EN-B on a good line will beat a D on a bad line every time. The performance difference is tiny in comparison to the potential difference between gliding through rising or sinking air.

Whether you're just bouncing along a thermic ridge or making an Alpine valley transition, gliding downwind in active air over the flats or just moving to a marked core nearby, a good pilot will more often than not arrive higher and in some cases earlier.

Knowing how fast to fly helps greatly here, but only when the line is right; route adaptation in the moment. All this is great, and very important, but there's definitely something else going on. It's not just a pilot's uncanny ability to choose good line after good line. One thing is very often overlooked: the concept of active gliding. When you add up all the advantages, the outcome can be impressive. And this step up in performance, unlike flying a hotter glider, is 100% free – in terms of both cash and extra risk.

Pilots A and B are on identical lines, gliders, harnesses and wing loading. Pilot B arrives higher after a 10km valley crossing. Why?

While he glides in active air, pilot A is taking photos and sucking on his drinks tube, allowing the air to roll him about in the harness. His wing is also lightly pitching forwards and backwards, inducing many tiny swing-throughs and wingovers. When flying alone he won't really notice these little inefficiencies. But if he's flying in company – skilful company – the difference can be seen and no longer ignored.

It can mean the difference between the pilot missing his next climb, or finding enough breathing space to play another move. It's crucial when you're arriving low. Throwing metres away when thermalling or gliding can only hurt our efficiency. So even when we're gliding, we pilots should act as the spring which dampens out roll, pitch and yaw, just as we do when we're thermalling. We're back to our familiar friend, the Golden Rule.

Controlling the pitch is obvious on glides; it's a very similar technique to the way we enter thermals. It's important to keep the speed of the pilot through the air as constant as possible. This can be done solely with brake, or with rear-riser input. The latter is the preferred method when flying the wing faster at lower angles of attack. Brakes at this point will induce some pretty unwieldy behaviour.

When a glider is pulled into turbulence and the brakes are used correctly to arrest the surge, an interesting thing happens. Height is gained from the system. But this happens only if the Golden Rule is maintained and the wing is not choked of its airspeed and forced to dive to regain it. This helps immensely on glides.

Controlling the roll is as simple as choosing which configuration you'd like your karabiners in. The answer is 'level'. Remaining 'loose to listen and firm to react' in the harness will enable the sensitive pilot to roll towards the side that's lifting, halting it.

Before it drops down under the extra weight, the pilot should roll off, and so on. All the while he's controlling yaw and pitch (yaw is simply asymmetrical pitch, and may require some roll authority too).

The earlier a pilot reacts with these small adjustments, the less reaction is required. Again, anticipation has nothing to do with it; this is basic balance and sense of motion. The more a pilot practises, the more intuitive it will become. The less a pilot breaks the Golden Rule while gliding, the better the glide will be. Also important is the ability to maintain a true course, with no meandering. A straight line is the best way from A to B, unless you're searching for something.

It's a little like multi-tasking, and this is why it belongs in the list of efficiency tools. If we can't climb efficiently, or we're on a badly chosen route, these high-end concepts are of very little use.

The need for speed

WE INCREASE our average speed by first having a solid route plan, which allows us to move easily over the terrain. We follow the flow of the day, both heating and valley wind aspects, and obviously not banging our heads against strong headwinds in the flatlands.

It's important to pick good lines along those routes and then, as I described in the previous section, to glide efficiently along those lines. This is so we avoid losing too much height while flowing. Remember the phrase: "We have to earn a move to play a move." Nothing stops us playing moves more quickly than having to stop to earn them. The less we have to climb, the faster we can flow. It's all quite obvious really, but it's the crux of flying fast. Lose less height, waste less time going round in circles, and you'll automatically see an increase in average speed.

A far more accomplished pilot than me once said that he dislikes thermalling for the reason that we are going in the wrong direction for 50% of the time! Sounds strange but he's right.

Next is flying at the correct speed for the day, or more importantly for the part of the sky that you're about to enter. You need the ability to change gears, flying faster or slower depending on what's ahead. If you've got a big blue hole to cross it may not be the best time to scrimp on time spent climbing beforehand. And it may not be the best time to glide full speed – usually a bad idea unless you can see your next moonbeam climb ahead.

But the opposite is also true: in an active sky with multiple thermal markers and solid clouds ahead, there's very little reason to hang back. A faster pilot than I once said, for that sort of sky: "Give as much gas as you can while still holding the nose open." That's quite important, because having a heavy foot for its own sake can lose more height, time and confidence should the glider decide to stop flying in the active sky that we're accelerating hard through.

It's often said that flying too slowly can hurt our average speed more than flying too fast, but exercise caution and moderation here.

And, of course, there's the practical aspect of holding the glider open at speed as you hurtle through turbulence.

Rather than being an exact science, how much speed I tend to use depends on the air that I'm in and the climb that I'm expecting. If there's a very good chance that the climb ahead is strong, I'll really use as much as I feel comfortable with. When I'm gliding crosswind or into a headwind, my rule of thumb is to accelerate the wing to get my groundspeed as close as I can to the trim speed of the wing – how scientific that is I'm not sure. This is just for best glide, even when searching.

The stronger the headwind, the more gas I'll give. I normally see an increase in my glide angle and play with this until I'm happy with what I'm doing. But as I've said before, it's important to have a good idea where the next climb will be, not just to choose best glide to the ground. Unless you're heading into goal.

Gliding efficiently

So flying fast and maximising the day doesn't rely solely on speed-to-fly theory, known as MacCready's, and it definitely doesn't mean having a heavy foot. It's more subtle than that. Efficient glides along solid lines are more important so we arrive high on the next step of the flight. However, judging how high we need to climb to cross the next obstacle is, for me, one of the highest levels of the pyramid of progression.

Treat every glide as an obstacle, whether you're crossing a valley, a flat forest, a plateau or just heading for the next trigger point on your route. Knowing how much height you really need will enable you to spend less time climbing and more time gliding. It's risky in the beginning, but with experience pilots can leave thermals earlier and push on, leaving more conservative pilots far behind. This is another difference between top competition pilots and hobby pilots: not only thermalling skills, but the ability during the climb to work out the height needed to be safely over the next hotspot. It's a high-level skill indeed, and one I'm still working on.

One main reason to push on is because a pilot hits a known inversion. Endless circling and efficient mapping is needed. But if the

pilot recognises that there's a deep layer of active air beneath, it's faster to make more short glides than long periods of slow climbing just to glide on and sink beneath the inversion again and again.

Something that I witness very often is a pilot's unwillingness to push on. "Never leave lift" is a valid principle, but not so valid if you can see another climb a few kilometres further along the ridge.

Only if there's a long crossing on which every metre is vital should pilots stay put and invest time, so they risk less on the crossing. Remember the section on cruxes? Knowing when to leave is the highest level of skill, and requires pilots to have all the lower levels in the hand. Trying to use the highest levels when the lower levels are weak will see very sketchy results.

This then is my mini-guide to going fast:

1. Choose a solid line that goes with the flow of the day
2. Glide efficiently at the correct speed for the part of sky ahead
3. Take only what you need. Don't squander time but invest it
4. Learn to thermal well: always remember there's nothing basic about these basic skills.

Look up at your wing

When I learnt to fly I was told – and I still hear it to this day – that pilots should not look at their wings, but should be able to tell what the wing is doing at any moment just by feel. This is both good and bad advice.

Over the years I found that if I felt something I didn't recognise I would look up. Next time I felt it, I'd know what it was. Flying at speed is very different, though, as the penalty for a blowout can be quite intense if it's allowed to get out of hand because of a slower-than-perfect reaction. Not ideal really.

When we're flying accelerated it's important to scan the leading edge, looking for areas of deformity. I'm not talking about staring constantly upwards, but at least half the time, and even more when things get rowdy. We must be ready to use what we have to hand to keep the glider flying. If we rely only on feeling the positive pressure through our legs as we hold the nose down, we're missing vital early warnings.

If we do feel the pressure drop through our hugely strong leg muscles, something's already gone wrong. Remember that the earlier we react to something the less we have to react? This is the perfect example. Our eyes are far more likely to pick up early warnings, such as a large pitch movement or a deformation in the cells; this is important information about what's coming next.

Experience tells us that a given amount of profile bending requires this much intervention by the pilot. But remember that if it all feels too much, smoothly release the speed system and then control the pitch, yaw and roll conventionally, until you're confident again that the wing can be flown at higher speed. Accelerated blowouts are to be discouraged, especially in rowdy air.

Respect the speed system, especially on modern wings with high aspect ratios. Things can get out of hand quickly; twists and cravats are public enemy number one. Obviously, when flying at speed, always allow a safety margin between pilot and terrain. When things go wrong they tend to go wrong in a spectacular fashion, sometimes to a magnitude greater then we expect.

Flying at speed through strong air and turbulence

Many years ago there were two schools of thought about how best to control the wing at speed in strong air. Both made sense on paper, but in the real world one seriously lacked the finesse of feeling needed to deal with what is quite an important part of flying fast: holding the nose open at speed, quite possibly in less than perfect laboratory conditions.

First, let's discuss the one that slowly lost favour, one that I always had my doubts about. **Pumping the speed system** using the leg muscles rather than the hands to stop overly aggressive pitch and yaw movements in the canopy.

Simply put, if the glider surged forward the pilot quickly released the speed system to keep the glider in its correct position. If the glider got knocked back, more speed was applied to push the nose further forward.

This all seemed very clumsy to me, and went against one of the principles of listening to the glider: getting the feedback through the

smallest muscles possible.

The quadriceps are extremely ill-suited to this job, as they're too strong to feel light differences in pressure. That leads to slow and clumsy control of something that can go wrong very quickly. This alone should rule out this method as the primary way of keeping the angle of attack positive in less than benign conditions.

A much more useful technique is **rear-riser control**. Manufacturers seem to have got it right with the assistance they've given pilots over the years and they can now control the leading edge with the help of handles sewn into or balls mounted in the rear risers.

Used together with looking up, a light pressure applied through the rear risers affords a wealth of information to the pilot, allowing him to really explore the polar curve of the latest technology.

When modern wings are accelerated past one-third speed, any use of the brakes can see some very strange yawing and even collapses occurring. However, with up to a quarter-gas applied the brakes can still be used, depending on glider type of course. But anything after that should be controlled with the rear risers.

As the speed system is smoothly applied, both hands should be securely gripping the rear risers, using either the handles supplied or simply around the riser near the maillon. Apply slight pressure, although not enough to deform the wing. The brakes should still be in the correct hands and the wrap can be released, depending on the length of the brake fan.

The rear risers can control both pitch and yaw in the same way that the brakes can, with one subtle difference. The risers need more power to be effective, but should be used to give the correct amount of input and only for the amount of time it's needed.

The wing should be allowed to fly most of the time, and reactions should be very much like the mirror we spoke of earlier. If the glider shoots forward, the risers should be snatched – with control – until the glider remains in place. The earlier we react, the less we have to react, and our arms should be relaxed at all times. Stiff arms are terrible at listening to what the wing is telling us through the risers.

Rear-riser control is more subtle than using the brakes and takes a lot of practice. The most important feature of rear-riser control is to

not hold the risers down: spins and stalls are sure to follow heavy-handedness while using this technique.

Instead, it's better to learn with half-speed in calm air before blatting full-speed along an Alpine ridge in springtime. There's a time and a place for accelerated flight, so keep it sensible. I'll add here that rear-riser control is not perfect but it's the best we have so far.

Losing the nose and suffering a collapse

Loss of the nose can damage confidence and cause a pilot to go and land with ruffled feathers. That's because rear-riser control was not up to the task at hand, of flying in very strong conditions with over half speedbar applied.

Flying fast, using this technique, while gliding efficiently along strong, solid lines around a well-planned route, will only help if a pilot's lower levels of skills are polished. Arriving at the perfect spot at the perfect height with less than perfect mapping and carving skills won't help the cause. Likewise, needing multiple attempts to leave the hill in less than perfect conditions will see the sweaty pilot climbing back up to launch.

As I have said, understanding this simple line of progress will allow pilots to concentrate on the level that they're on until the next level starts to make itself clear to them.

Paragliding is a long-time sport and can't be learned in ten minutes. But knowing what the next levels are will allow a pilot structured steady progress. Next we'll discuss what makes a pilot a born 'natural'.

Natural flying

WHEN PEOPLE say a pilot is a natural, what exactly do they mean? Technique and application will help a pilot succeed, but what are the traits that are naturally, perhaps even genetically, within a good pilot? We'll only discuss thermalling here, as comparing one pilot to another through the whole range of our game of 3D chess would be like comparing that great game's players.

Reacting without conscious thought is a common theme in these pages. It helps greatly to have all levels of the progression pyramid in hand and bone deep. For intermediate and even advanced pilots, the game played relies heavily on the amount of bandwidth free after the immediate task of glider control. Any pilot who can control their wing, carve and map the thermal in his sleep will do better than one who is staring at the wing at every rotation, or worse, at a dot on his instrument's screen, perhaps crudely indicating where the last thermal was felt.

One's natural ability to thermal well relies on several things. One of those is balance. Balance in the harness is crucial, first for feeling and then for instantaneously giving the correct reaction with the right timing, with either brakes or weightshift. This mostly involves a pilot's core strength, and goes back to the analogue concept of the big three – loose to listen, firm to react.

This has nothing to do with anticipation. It's better to answer a real-time question than to shout out an answer before the question is even asked. If you anticipate wrongly, the Golden Rule will surely be broken; guesswork when thermalling is not to be encouraged. Reacting with correct inputs and timing is what we're striving for here.

The other natural trait that I believe all great pilots share is a sense of acceleration – an inner gyroscope. This is the ability to sense minute movements in all three planes. Forwards, backwards, left, right, up and of course down.

Senses of acceleration and balance are a pilot's natural secret weapons and can't be taught. They're within a pilot from birth. But

of course they can and must be honed with countless hours of flying.

Over my years of flying I found that I'd become dependent on the sound of the vario. That's not perfect really. Aurally seeking cores is clumsy, and we're blocking out many of the subtle clues that our sensitivity skills are there for.

Any pilot who can listen to the air and interpret the movements in the harness, reacting to what he or she hears or feels, will have an automatic advantage over someone heavy-handed, who can't sense what body movement fits the puzzle thrown at him by the climb. This leads to an ignorance about when to open up the carve as it needs to be moved around the sky. Hunting thermals relies on all our senses, not just homing in on the sound that our vario makes.

I would also recommend that pilots don't come to rely on an instrument's thermal mapping technology. Although it can be quite accurate, this is about as far removed as can be from what I'm talking about. Technology opposes feeling and skill. It varies from pilot to pilot, but a disappointing number rely on technology and never really experience the true soul of the sport.

I've even had discussions with pilots in the past about the notion of thermal-spotting glasses. This is a classic example of beginners who want to be able to do the sport instantly, or even worse, collect sports.

They lack the will to put the time in and learn the sport properly. Since there's no such thing, thankfully, they're forced to do the apprenticeship with all its frustrations and rewards.

If we want to truly break through and perform to the best of our natural abilities, we need to get as far away from technology as possible, relying more on our senses and less on our instruments. The more we train without the distraction of beeps, the more we can focus on our inner gyroscope. Try it the next time you're not scared of going down.

For pilots who've completed the progression pyramid the final step remains: give up the vario and try to feel. I believe that this is the last mile of the route to free-flight nirvana.

If you fly without the aid of technology for a time, when you use it again it will not be a necessity but just a confirmation of what you believe. This truly is the highest step of progression and the true soul of our amazing sport.

Glossary

4-for-90 rule: A thermalling guideline that states it should take four seconds to travel 90-degrees of a 360-degree turn, and 16 seconds to make the full circle
45-degree rule: A guideline that states a pilot should always keep the edge of the cumulus cloud they are under at 45-degrees to them. In this way they will be able to escape the cloud without getting sucked in.
Active piloting: Responding to what the glider is doing by using brakes and weightshift
Altocumulus: Mid-level heaped cloud
Anabatic flow: Wind flowing up a hillside caused by the sun heating the land. From the Greek anabatos
Angle of attack: The angle between the glider and the airflow
Anti-cyclone: A large-scale circulation of winds around a central region of high atmospheric pressure, clockwise in the Northern Hemisphere, anti-clockwise in the Southern Hemisphere
Apprentice: In the context of this book and the Pyramid of Progression, it is a pilot who has qualified from school and is learning to fly thermals and cross country. The focus is on glider handling and thermalling
Bank: The angle between the glider's normal axis and the horizon
Big ears and speedbar: Fast descent technique of folding in the paraglider wingtips and pushing the accelerator system (speedbar):
Bite: How a glider feels when it hits a thermal or in a turn – biting in, like crunching on an apple
Blowout: When a glider collapses in flight. "Stupidly, I dived into the lee and got a massive blowout!"
Blue days: Days when there are no clouds – tricky as cumulus clouds show the thermals
Boundary layer: The bit of the atmosphere in which we fly
Bowling ball line: The 'straight through the middle of the gaggle' line that some pilots take when joining a thermal. Not recommended.

Brakes: The two lines that go to the back of the paraglider, controlled by the pilot through the brake handles
Bridges: Areas of lift or routes through the air that allow pilots to make otherwise difficult transitions, eg using convergence to cross a valley
Cadence: Your tempo in the air. The aim is to be smooth, so your cadence should be consistent and even
Carving: The way a glider moves through the air while turning or thermalling
Cascades: A dramatic sequence of collapses on a paraglider, each worse than the other
Chinook: Föhn winds in the interior west of North America, where the Canadian Prairies and Great Plains meet various mountain ranges. The original usage is in reference to wet, warm coastal winds in the Pacific Northwest. Also a helicopter. Both are to be avoided.
Cirrus: High cloud
Classic half-wrap: A way of holding the brakes
Climb rate: How fast you are climbing in a thermal. Varios average out the speed over time so you get a true picture. Measured in metres per second (m/s) or thousands of feet per minute (3-up).
Climbing: The art of going up in a thermal
Cloud development: How clouds change during their life cycle and over the course of a day
Cloud flying: Flying in cloud
Cloud streets: Cumulus clouds in a line. Very good for flying
Cloudsuck: Strong, consistent, smooth lift near the base of and inside some cumulus clouds. Technically the same as strong lift but can be dangerous as it will pull you into the cloud faster than you can spiral down
Cloudbase: The bottom of a cumulus cloud
Cooperative conditions: An air mass that is good for flying
Col or pass: Geographic feature between two hills
Collapse: When a part of a paraglider deflates
Comfort: An important aspect of flying and glider design, often overlooked

Competition gliders: Generic name for high performance gliders used in competition
Confidence: Important to have
Congestus: A towering, heaped cumulus cloud, but not yet a cu-nim (storm cloud)
Conservative flying: Staying high and not going too fast or taking risks that might put you on the ground
Convection: The process of the air being heated by the ground and rising
Convergence: Where two or more winds meet
Core: The central part of a thermal, where you want to be
Coriolis effect: The effect of the Earth's rotation
Corkscrew line: Related to the 45-degree rule it allows you to make good, fast progress along cloudstreets
Cravat: Where the wingtip of a paraglider gets caught in the lines
Cross-brakes method: A way to launch a paraglider
Cruxes: The hardest parts of a cross country route
Cumulonimbus: A large cloud that will rain or storm. Generally higher than they are wide
Cumulus: A white fluffy cloud that we all dream about in our sleep. Perfect for flying
Decision-making: A crucial part of flying
Deflation: When part of the paraglider collapses
Dewpoint: The temperature at which dew forms. A measure of atmospheric moisture
Downburst: A burst of rain, virga and wind from a cumulonimbus cloud
Downwind: Going with the wind
Drag: Resistance through the air caused by the glider, the pilot or the lines
Dragon grip: A way of holding the brakes that involves putting your whole hand through the brake handles
Drift: Floating across the landscape underneath a cloud. Also the direction you are blown in the wind.
Dust devil: A small whirlwind caused by thermal activity, visible because of the dust it picks up

Efficiency: Efficient flying is fast flying
EN A / B / C / D: EN means European Norm. It's the almost-universal system of testing and rating paragliders. It measures responses to induced collapses and other manouevres. A requires the least time or pilot input for the glider to regain normal flight, D requires more time or pilot input
Engine and exhaust: A way of thinking about storm clouds and cells – one part sucks in air, the other dumps it out again. Avoid
Excitable conditions: An air mass that is prone to overdevelopment
FAI: Fédération Aéronautique Internationale, the World AirSports Federation. Oversees many competitions and all world records
FAI triangle: A triangle-shaped cross country route that starts and finishes at the same place, that also conforms to certain official rules over its shape. Considered the purest and hardest form of defined XC
Falling leaf: A technique to increase drag and lose height. Involves pulling in big ears, standing up in the harness (more drag) and flying gently side to side
Fear: Normal, useful, necessary. Too little or too much can be a bad thing.
Feedback: The feeling you get from what the glider, and therefore the air, is doing
Feeling: Sensitivity to lift, the glider's movements and the air
Final glide: The last glide of the day, or the glide into goal in a competition task
Fizzy air: Unstable air that is 'fizzing' with thermic activity
Flatland flying: Flying in relatively flat terrain
Flow: The idea of psychological flow – "I was in a state of flow, everything just worked" – and also related to the flow of the day principle
Flow of the day principle: The idea that there is a natural 'flow' to the day in the mountains. East faces work in the morning, southerly faces (northerly in S Hemisphere) during the day, west faces in the evening Predictable valley winds also set up. Flow of the day

principle uses these predictable factors to fly routes more easily through the mountains.
Flush face: A mountain slope which is neither a good place to stay up, or in dangerous lee, but simply one where you will be flushed along it, maintaining height or going down
Föhn: A type of dry, warm, down-slope wind that occurs in the lee of a mountain range
Four faces: The author divides mountains into four different types of faces: the bridge; protected lee; flush face; and rotor lee. Identifying which face is which allows a pilot to navigate safely through mountain terrain
Fractal rotor: The author's name for large-scale rotor caused by the Föhn
Front: A boundary separating two masses of air of different densities
Fun: Keep it in mind
G-force: The feeling you get in a spiral dive or other strong manouevre. Some love it, others hate it
Gaggle: A group of pilots in a thermal
Gaggle flying: Flying with a group of pilots
Getting stuck: Having to spend a long time soaring or climbing, instead of being high and making distance
Glide angle: The angle of your descent through the air
Goal: The end-point in a competition task or defined cross-country flight
Goals: Things you adopt to help focus your flying, eg "I'd like to fly 100km"
Golden Rule: A rule the author uses that states: "However their wing moves, the pilot shall keep their own body's progress through the air as smooth and constant as possible."
Goldilocks day: The perfect day, neither too stable or unstable, but just right
GPS: Electronic instrument that uses Global Positioning System to give us speed and position info
Groundspeed: How fast we are travelling across the landscape

Grunt hand: Your non-dominant hand. If you write with your right hand, your left hand is your grunt hand
Gust front: The outflow of air that precedes a cumulonimbus
Hacking: Doing something roughly but badly, without finesse
Hail: Frozen peas falling from the table of the gods
Hammer days: Really great flying days in the Alps, when 200km+ flights are possible
Haze domes: The hazy, milky cloud that appears at the top of a thermal on hot, stable days
Headwind: When flying directly into wind
Heaped cumulus: A fat cumulus cloud
Heat low: When the Alps heat up during the day they suck in so much air that air pressure across the entire region is lowered. This is the heat low
Heat low flow: The regular and predictable flow of air around the Alps that is associated with the heat low
Heating effect: The way the sun warms different aspects in the mountains at different times. The sun heats the ground, the ground heats the air, the air rises
High pressure days: Blue skies, light winds, high cloudbase
Hotspots: Hot areas on the ground where thermals are incubated and then born
Inertia effect: The way an object will stay in motion in a straight line unless acted on by a force. In our case we're talking about thermals rising up through an air mass, unstoppable until the air either condenses at cloudbase or they hit an inversion
Instability: Air that is unstable and good for thermals
Intermediate gliders: Gliders aimed at recreational pilots who fly 50-100 hours a year
Inversions: A temperature boundary in the air, where warm air overlies cooler air. Stops thermals
Katabatic flow: Downlope breeze caused by cooling air in the evening
Kick-off: Where thermals leave the ground. It can be a treeline or break in terrain in the flatlands, or a cliff or peak in the mountains
Laminar flow: Smooth wind with little or no turbulence

Lapse rate: The rate at which atmospheric temperature decreases as you go higher. The terminology comes from the word lapse, in the sense of a decrease or decline
Lazy conditions: A slow flying day, possibly blue with no clouds, one that takes time to get going
Leading edge: The front edge of a paraglider
Lee-side flying: Flying in the lee of the meteorological or valley wind
Lines: The string bits on a paraglider
Low saves: Catching a thermal close to the ground
Magic air: Air that is smooth and going up everywhere. Often in the evening, often restitution
Magnet effect: The idea that heated mountain faces draw air up to them from the valley below, like magnets pull in iron filings
Major terrain: Hills. Part of the author's classification system for the different places we fly: minor, major and mega
Mapping: Mental mapping is the process of understanding where you are in relation to the thermal or air you are flying in. It can also mean assessing the terrain below and in front of you, to work out where the next thermal might be or what the air is doing
Master: The top level in the pyramid of progression in this book
MacCready: Paul MacCready was one of the first to suggest the speed-to-fly principle, which is used by soaring pilots to determine what speed they should be flying through the air. The aim is to maximise the average XC speed by optimising airspeed in both lift and sink.
Mega terrain: Mountains. See Major terrain
Minor terrain: Flatlands. See Major terrain
Mistral: A strong, cold, northwesterly wind that blows from southern France into the Gulf of Lion in the northern Mediterranean, with sustained winds often exceeding 40km/h, sometimes reaching 100km/h. It is most common in winter and spring, and strongest in the transition between the two seasons
Mitsos method: A way to launch a paraglider in strong wind using the risers, not the brakes

Moonbeam: A fantastic, beautiful thermal. "That was a moonbeam!"
Observation: One of the most important skills you can develop in flying. Observe more, fly better
Orographic cloud: Cloud that forms when moist air is pushed up over an object or hill
Overdevelopment: When clouds develop into storm clouds, or when the sky fills out with 'spreadout' cloud
Pitch: An aspect of flight dynamics. Forward and back motion.
Pressure drop effect: When the local air pressure drops, perhaps because of a new air mass or a developing storm, it can trigger thermals. This is the pressure drop effect.
Pyramid of Progression: A structured approach to learning to fly cross country. The core idea in this book
Quadrant map: A technical way of mentally mapping a thermal so a pilot can home in on the core
Rear-riser control: Controlling a paraglider while on glide and speedbar by using the back risers
Restitution: Evening lift 'everywhere'
Ridge soaring: Flying up and down a ridge in dynamic lift (the wind)
Roll: An aspect of flight dynamics. The rotating of a wing on its longitudinal axis
Rotor: Turbulent air in the lee of (behind) an object
Shear: A difference in wind speed or direction between two air masses, often turbulent
Sink rate: The speed at which you are going down
Snowline: Where the snow ends in the Alps. Often a good trigger for thermals
Soft skills: Your internal eagle
Solar heating: The Sun heating the ground
Sources and triggers: The source is where the warm air is from, the trigger is what sets the warm air off so it rises. For example, a brown field is the source, the treeline downwind of it would be the trigger

Speedbar: The accelerator system on a paraglider. Applied by the legs
Spheres of concentration: Where you can focus. When stressed your sphere of concentration is reduced to one metre wide – just you and the risers. When relaxed, you can look 10km down valley
Spiral dive: A series of steeply banked 360º turns
Spreadout: When clouds develop and spread across the sky, killing convection and spoiling our fun
Stable days: Days where the properties of the air mass and air pressure mean an absence of thermals, despite sun
Stall: Applying the brakes so the glider stops forward flight and collapses behind you
Standard grip: A way of holding the brakes on a paraglider
Stau cloud: A type of cloud associated with the föhn, it means blockage
Sticky air: Air that is slow to get moving, often associated with high pressure days
Stubborn conditions: Difficult flying
Sweet spot: The point on your glider where you apply just the right amount of brake so the glider is turning beautifully and feels in balance. "Sweet!"
Synoptic flow: The meteorological wind
Tearaway point: Where a thermal leaves the ground
Thermal: What we love. Rising columns of warm air topped by a perfect cumulus cloud (in theory)
Three-axis method: A way of launching a paraglider
Thunderstorms: Related to the family of convection clouds, but angry and unreasonable. Leave them alone
Topography: The ground below you, the hills, mountains and flatlands you fly through
Towering cumulus: A tall, puffy cloud, signifying that there is a lot of energy in the day
Tractor-beam sink: In science fiction this is a hypothetical beam of energy that can be used to move objects such as spaceships or hold them stationary. In flying it's when you sink relentlessly to the ground. "I was tractor-beamed out the sky, man!"

Trailing edge: The back edge of a paraglider
Trim speed: The speed of a paraglider when flown 'hands-up', ie with no brake input
Turbulence: Air that is not smooth
Turn reversal: A thermalling technique that says you should first turn a little bit one way, then the other when you enter a thermal
Turnpoint: Used in competition and in defined cross-country flying. A dedicated point, physical like a building or simply a GPS point in the air, that pilots must reach before carrying on
Twist: When your glider and you have somehow twisted, perhaps following a collapse and recovery, and the risers are crossed in flight. Not great
Valley crossing: Crossing a valley, often the crux of a cross country flight in the mountains
Valley winds: The system of winds and airflow that sets up during the day as mountains heat up and draw air in. Can be strong. Essential to understand for mountain flying
Vario: Electronic instrument that tells a pilot if they are going up or down
Venturi: Where air speeds up as it passes through a gap or narrowing
Volatile air: An unstable air mass that is probably going to lead to overdevelopment and storms
Weightshift: The technique of shifting your bodyweight so the glider turns
Wildschonau effect: An area that is protected from föhn conditions because it is higher than its neighbouring valley. Named after the Wildschonau Valley in Austria
Wing loading: The loaded weight of the glider divided by the area of the wing
Wing Tsun: A concept-based Chinese martial art and form of self-defence
Wraps: The technique of shortening the brakes on a paraglider by wrapping the brake lines around a hand
XC: Cross-country flying

Yaw: The rotation of a wing from side-to-side, as if around a mast on a yacht

Units

1m = 3.28ft
100m = 328ft
1,000m = 1,093 yards
1km = 0.62 miles
100km = 62.14 miles
10ft = 3.05m
1,000ft = 304.8m
1 mile = 1,609m (1.6km)
100 miles = 160.94km
0.5m/s = 98.5 ft per minute
1m/s = 197 ft per minute
2m/s = 394 ft per minute
3m/s = 591 ft per minute
5m/s = 984 ft per minute
10m/s = 1,969 ft per minute
1km/h = 0.54 knots = 0.62mph
1 knot = 1.15mph = 1.85km/h
1mph = 0.87 knots = 1.61km/h
10km/h = 5.4knots = 6.2mph
15km/h = 8.1 knots = 9.32mph
32km/h = 17.3 knots = 20mph
50km/h = 27 knots = 31.07mph

About the author

KELLY FARINA has been flying paragliders full time since 1996. He's mainly an Alpine pilot, with a little over 3,000 hours to his name. These pages are a culmination of nearly two decades of experience and training.

He's been based for most of his paragliding career in the Zillertal, in Austria. There he learnt from some of Austria's best XC pilots, including former world champion Stephan Stiegler and world record holder Thomas Walder.

From 1999 to 2009 Kelly competed in many FAI Category 2 competitions. He achieved several podium and top ten finishes in 2005-6, helping him to reach 18th place in the world rankings.

He was in the British team that won the 2005 Bleriot Cup against the French on their home soil in the Alpes-Maritimes. That same year he was technical director and organiser of the British Open in Mayrhofen. It was a huge success, with more tasks and kilometres flown, and more pilots in goal, than any previous British Open.

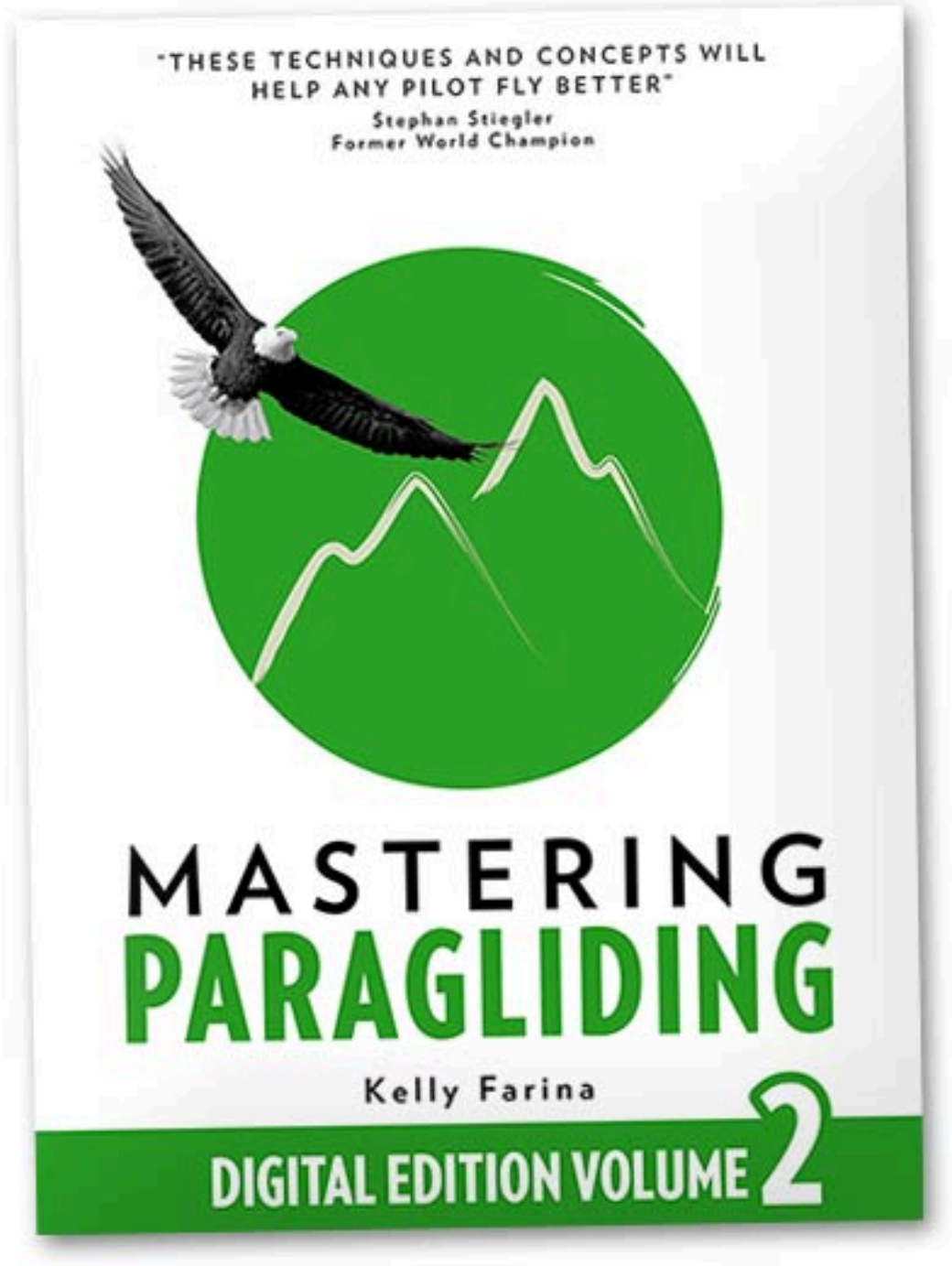
The following year Kelly won a place in the British team at the European Championships, held in Morzine, France. His team-mates included Russell Ogden, Bruce Goldsmith, Adrian Thomas and Mark Watts. Qualifying for the 2006 PWC in Fiesch, Switzerland, was another highlight.

Kelly left the comp scene in 2009, after the emergence of the two-liners, to concentrate on coaching. He's been guiding and coaching pilots since 2002. His motto for many years has been: "The fewer mistakes a pilot makes, the less performance they need." Using simple to understand rules and concepts, he's tried to quantify and explain the 'black art' of paragliding. He operates in many different places in Europe, and pilots now visit from all over the world to train with him.

Kelly says he usually sees results in a short time, in the form of safe and steady XC flying or smooth and technically sound thermalling. His company Austrian Arena can be found at its new base in Bassano, visiting both the Dolomites and Greifenburg.

www.austrianarena.com

Mastering Paragliding: Volume 2



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